June 5, 1919 American Machinist Vol. 50, No. 23

What a Tinsmith Can Do in a Machine Shop

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The value of oil chutes, spatter guards, grinding wheel shields and other similar devices is obvious, but their cost if made outside the plant may be considerable. The author tells of the achievements of the shop tinsmith of a New England plant in producing homemade time and labor savers which would be useful anywhere. It is quite possible that the average tinsmith cannot reach the heights attained by this particular individual in analyzing machine-tool operations and designing fittings to improve their efficiency, but he can at least handle the actual construction.

A TINSMITH can be of great benefit in a machine shop if his work is properly directed. Sheet metal is a peculiarly adaptable material and can be shaped and adjusted to serve a great many purposes. It can be quickly cut and formed and is so light that the products made of it can be attached almost anywhere. The many different articles required in a machine shop offer an opportunity for an efficient exploitation of the tinsmith's art. This article tells of the various things a tinsmith has made in the plants of the Greenfield Tap and Die Corporation, Greenfield, Mass., where many useful methods of applying sheet metal have been put into operation. First we will take up attachments to machines for separating cutting oil from the chips and products as all three drop away from the point of the cutting tool.

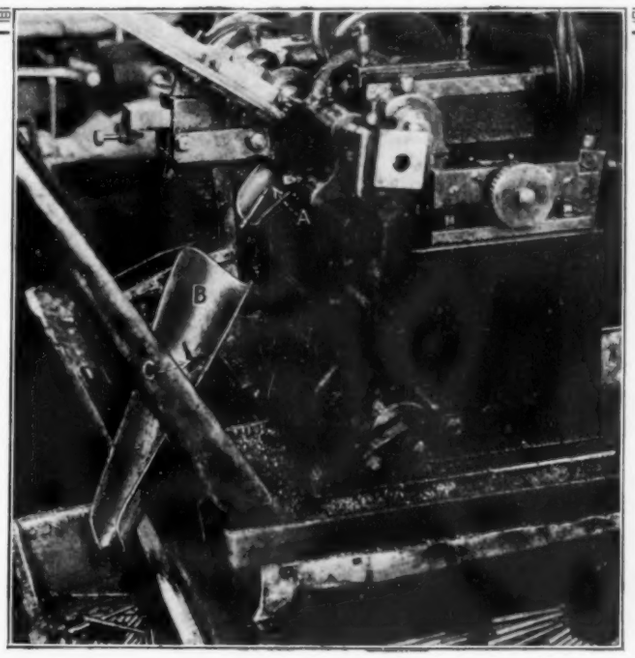


FIG. 1. CHUTE FOR SEPARATING SCREW-MACHINE PRODUCTS FROM OIL AND CHIPS

The simplest form of such a device is a small galvanized-iron chute bent into the form of an angle iron and attached under the point of the cutting tool. Part way down the chute an arrow-shaped slit is cut across the angle. As the oil and products fall down the chute the oil runs through the slit into the pan of the machine to be taken up by the oil pump. The products continue down the chute and drop into a box provided for the purpose.

A sharp point should be left just above the lower part of the slit and bent down so that the oil will be led to the proper point and run off in a steady stream instead of half of it jumping the slit and continuing down the chute, as a small part of the oil usually gets by this slit and it is necessary to cut a second slit a little farther down. This takes care of nearly all the remainder of the oil.

The oil that clings to the product itself drains off while the product is resting in the dry-product box or pan. If both product and oil were allowed to drop into the bed of the machine a great deal of oil would be carried away with the product and wasted. The chute described is one of the simplest forms to separate oil from the product when the product is so much bigger than the chips that it can be picked out of the chips very easily. If the product and the chips are of about the same size and it is desired not to have them mixed together in the bed of the machine or even in the product box, the chips can be separated from the oil and the product by the arrangement illustrated in Fig. 1. A short chute *A* attached at a flat slope beneath the cutting point catches chips, oil and products as before. Below it and slightly beyond is a second chute *B*. The product, chips and most of the oil slide down the first short chute, and the chips and oil drop off the end into the pan of the machine. The product, however, comes down the short chute so fast that it jumps the gap between the two chutes, lands in chute *B* and slides down into the product box. The chute *B* is provided with an oil slit *C*, so that whatever oil jumps the gap with the product drains into the pan of the machine.

The delivery chute may be attached directly to the machine or it may be run through a hole cut in the shield or apron at the front of the machine. This shield, or apron, may itself be detachable, so that when it is removed the chute goes with it and forms no hindrance to working at the machine. Fig. 2 shows the shield.

The product box, Fig. 3, into which the chute discharges has a perforated false bottom, so that what oil comes down with the product drains off during the

FIG. 2. GALVANIZED-STEEL SHIELD

day into the real bottom below. Devices of this sort save a great deal of time for the workman, not only because he no longer has to pick out his products from among the chips and oil but because he can clean the machine much quicker when he does not have to look out for products. Since the oil and the chips do not fall together in the same stream a box placed in the right way will catch the chips almost dry. The oil saved through not being carried away with the product amounts to considerable in the course of a year; enough to pay for the simple little chutes and the time of building them.

On a machine where the product is automatically discharged by an attachment on the turret head as it draws back it is not necessary to extend the chute under the cutting point or under the oil. It is attached instead under the position where the product will be discharged on the back stroke. As the oil does not flow down the chute at all it is only necessary for the chute to deflect the product to a product box. The only oil that goes down the chute is the small amount which is knocked off from the turret tools simultaneously with the discharge of the product. This small amount is separated in the usual fashion by having a pointed slit in the chute.

It is sometimes advantageous to install a chute to carry the clean products down almost to the bottom of the pan or pail. Near the bottom the chute takes an upward direction for a sufficient distance to slow up the rapid motion of the product, so that it drops softly only a couple of inches instead of having to fall a couple of feet on another piece of product which it may spoil; or the end of the chute may be directed against a wooden block from which the product bounds off with just sufficient force to roll out of the way before the next piece comes down. Otherwise a heavy piece such as a tap falling upon another may spoil the threads of both. On very small, light work another arrangement has to be used, since it is too light to slide down a chute which cannot help but be sticky with oil. In this case it is necessary that the oil, instead of being separated, shall go down the same chute with the product in order to wash it down. Therefore the top of the chute is inserted so that it avoids catching, or bends aside the big chips from the cutting-off tool, allowing them to fall into the bed of the machine. The light product drops on the chute and gets stuck there, but the next burst of oil washes it down. In Fig. 4 products may be seen on the chute, while in Fig. 5 the next burst of oil is washing them down.

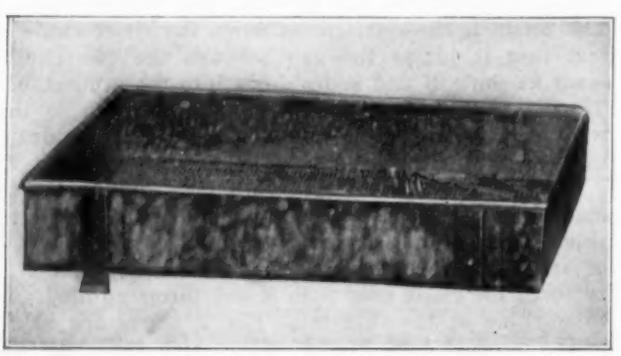


FIG. 3. PRODUCT BOX WITH FALSE BOTTOM

FIG. 4. PRODUCTS STALLED ON STICKY CHUTE

Where the shape of the machine allows, the chips may be caught in a catch box. This should be a shallow box into which the chips settle to the bottom while most of the oil flows over the top and back to the pump. At the end of the day the operator takes out the chip boxes, pours off the remainder of the oil and dumps the chips into a chip-collection truck.

In many processes it is necessary for the operator to hold the piece of product against the cutting tool with his fingers while it is under process, then pull it out and lay it in a box. If, however, a small chute, Fig. 6, is placed with the upper end just beneath the cutting tool, the operator can simply let go of the product, which slides down the chute into a product box. The chute is merely a piece of sheet-iron pipe like an ordinary eave-spout, with a piece of the top cut away in the form of a scoop and the edges securely bound, and extends almost beneath the operation part of the machine. The operator simply has to hold the product in place while the tool is working on it, and then flip it off the centers with his fingers when it falls into the spout and slides down to the product box beneath. It is important that the mouth of the chute

FIG. 5. PRODUCTS WASHED DOWN BY STREAM OF OIL

should be a few inches below and to the rear of the cutting point of the tool so that only a slight motion will be necessary to send the product down.

The motions saved are individually small, but their total at the end of a day is important, for if a workman's hand moves a yard in delivering product to the product box 1700 times a day, that is about a mile of motion for the hand alone, to say nothing of the 1700 repetitions of muscular movement which involve considerable fatigue.

The chute may discharge into boxes, pails or trucks standing ready or into a reservoir or container from which the next machine is supplied directly.

A piece of sheet-metal equipment which saves the handling of hot metal is shown in Fig. 7. This is a chute leading down from under the point where the product is discharged after a process which results in each piece being hot at one spot. This small slanting tube discharges at the lower end into a pail of cooling oil through a neat hole in the cover near the edge.

The pail is half full of oil and is provided with a wire basket that closely fits the inside diameter. The basket

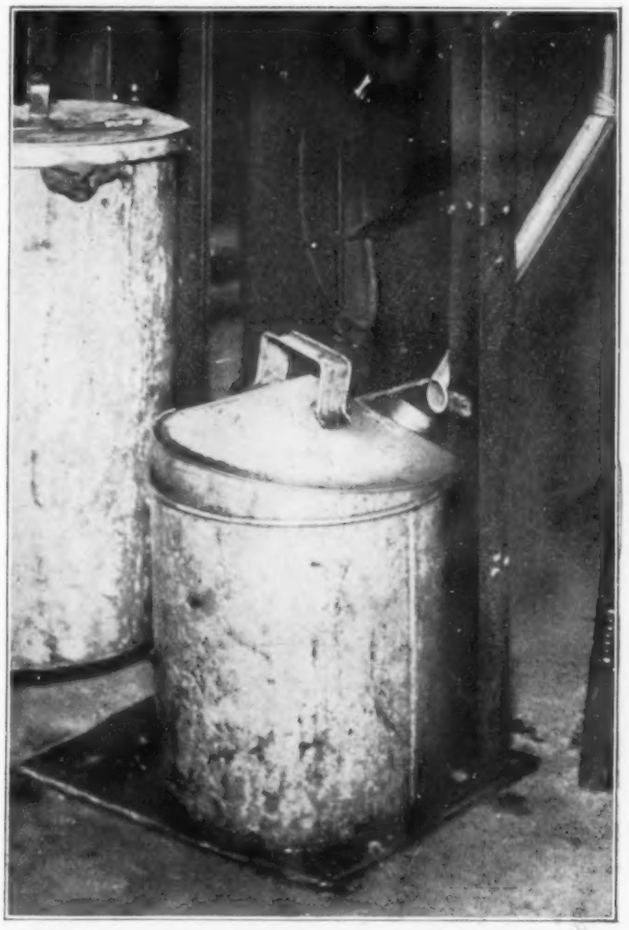


FIG. 7. CHUTE FOR DELIVERING HOT PIECES TO A COOLANT

has a stiff handle standing upright in the pail, but not high enough to interfere with the cover. When a job is completed the cover of the pail is lifted off and the basket lifted out of the oil and emptied.

Such chutes are inexpensive and can be curved in a variety of ways so as to discharge at the most convenient point either in readiness for the next process or into a box accessible for removal.

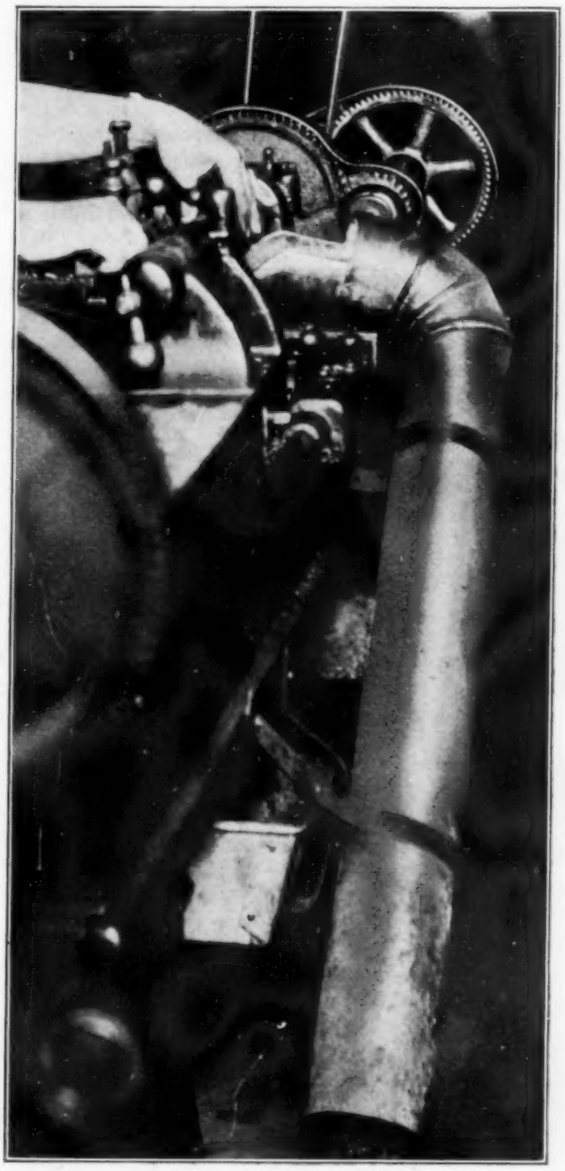


FIG. 6. A CLOSED CHUTE

Sheet-Metal Guards and Casings

A large and necessary field of work in the modern shop is the making of protective devices of all sorts, such as gear casings, belt guards, shields and aprons.

The grinding machine shown in Fig. 8 is an endless belt carrying glued emery and carborundum. Shanks of products are ground smooth by being held against it for a moment. The belt travels so fast that the danger of breakage makes the workmen afraid of it and warrants the use of the protecting casing which leaves only a foot or two of the belt surface open for application of the work. In case it is necessary to get at the mechanism or the belt for repairs, access may be had through the side door, which is on vertical hinges offset at the proper distance from the edge of the casting, so that the door when thrown open will remain open while the work is being done.

Fig. 9 shows a sheet-metal hood over the gears of a semi-automatic machine. Formerly this machine had a cast-iron hood which weighed 100 lb. or more, which was difficult to lift for changing the gears.

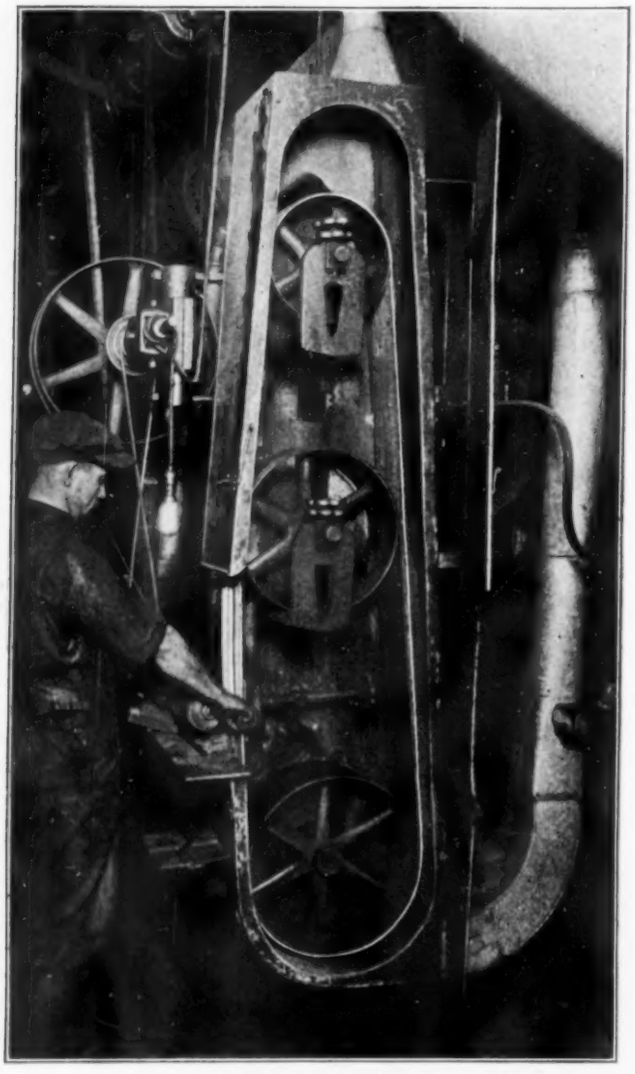


FIG. 8. GUARD FOR GRINDING BELT

The sheet iron of the hood is reinforced inside by straps of wrought iron and by angles; those in the middle, as shown in the figure, resting on the solid bearings along the center of the machine and supporting the weight of the hood. This leaves the edges of the sheet iron free of contact with the machine and prevents rattling.

A casing similar to that used on the polishing belt is put around polishing wheels and stones, as shown in Fig. 10. The side nearest the workman is hinged to the main casing and forms a door which gives easy access to the whole apparatus.

Tinsmith Can Design Casings for Grinding and Polishing Wheels

The tinsmith can also design casings to go around grinding wheels and polishing wheels so that they really fit the wheels. For instance, on one 3-in. wheel there used to be a large casing 1 ft. or more in diameter. The air suction in connection with the casing took away a great deal of the dust, but some sparks stuck to the wheel, went around again and came off at the top through the opening into the operator's face. It was very uncomfortable, besides being dangerous. A new case was designed, fitting closely around the wheel and coming well down in front. The restricted space increased the suction so much that almost all the sparks were taken away directly and those that did stick to the wheel and went around with it, on coming off, struck the low front of the casing instead of flying into the operator's face.

The effect of sparks on goggles or eyeglasses is shown by the micrograph in Fig. 11 taken from a lens after being used for 9½ hours. The reader has only to imagine what would happen to his eyes if they were in range of the rapid fire from the wheel. Equipping individual wheels and stones with cases that fit them closely is therefore important to health. Sheet-metal cases can be fitted much closer than cast iron or wrought iron and can be made of heavy enough material so that if the wheel bursts it may dent the casing, but the pieces instead of flying out will be churned around inside. When they do fly through the small front openings they will go directly downward and do the least possible harm.

Things to Be Considered

In designing these casings three things should be considered: The circumference of the circular part of the casing should be as nearly equal as possible to that of the wheel, taking into consideration ease of replacement of the wheel. The width of the casing across the face of the wheel should be as narrow as possible, after allowing enough clearance to prevent a piece of product which may slip from the operator's hand from binding between the wheel and the casing. The length of the

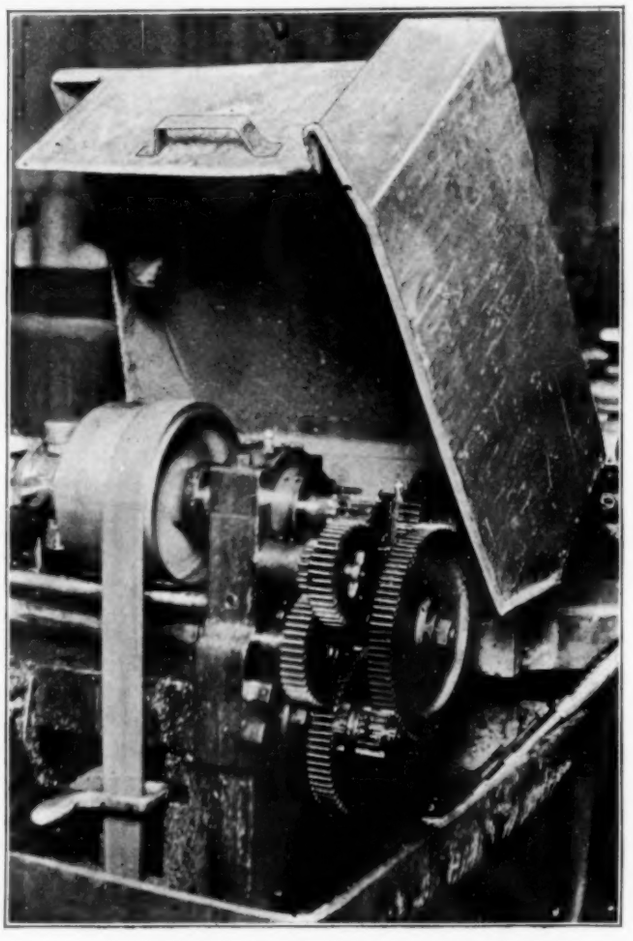


FIG. 9. REDUCTION GEAR SHIELD

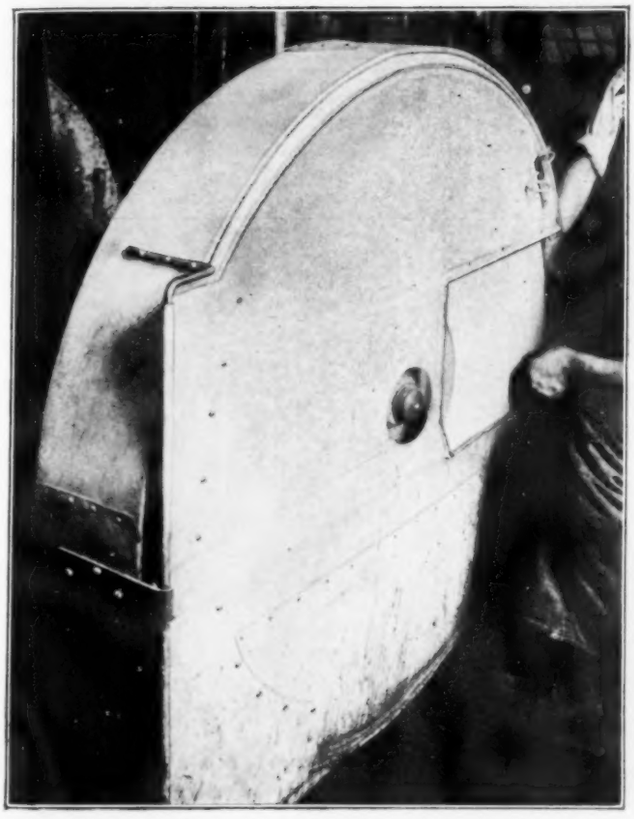


FIG. 10. SHIELD FOR VERTICAL POLISHING WHEEL

opening in the casing for the work should be kept as small as is consistent with the size of the product.

The form of the offtake of the exhaust pipe from the wheel depends upon the relative directions of the pipe and the rotation of the wheel. The offtake from the casing should be coincident with the line of flight of the sparks of emery thrown off.

If the wheel revolves upward and away from the operator the offtake should be vertically downward at the rear. If the wheel revolves downward from the operator the offtake should be horizontal at the rear, giving the sparks only a quarter revolution to cling to the wheel. When the direction of the offtake, as determined by the position of the exhaust main, necessitates a departure from the horizontal or vertical direction the pipe should be kept in the proper tangent.

Each branch exhaust should enter the main not at a right angle but at an acute angle in the direction of the draft, forming a Y. The pipe should have no sharp bends to check the speed of the flow and allow the dust to settle.

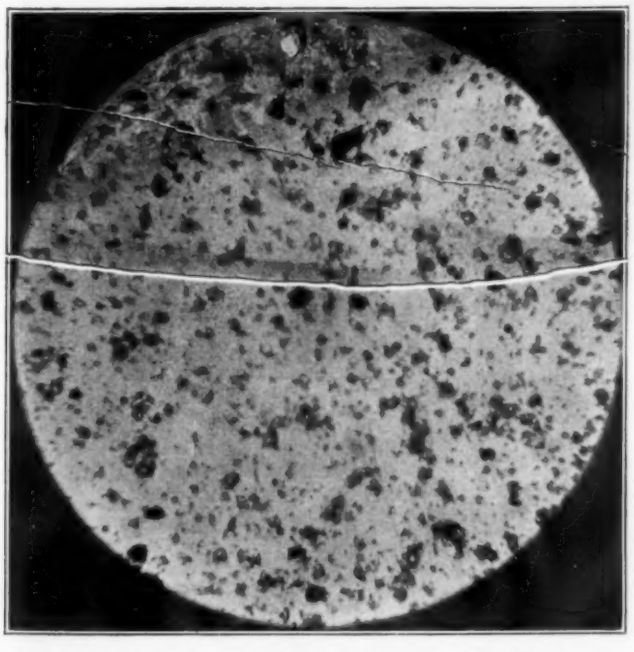


FIG. 11. MICROGRAPH OF LENS AFTER USE BY GRINDING-MACHINE OPERATOR

Preventing Oil From Spattering and Chips From Flying

For the comfort and safety of the operators, especially now that women are employed in the shop, it is necessary to prevent oil from spattering and chips from flying. For this purpose the shop tinsmith can be useful in fitting sheet-metal walls or cases around the machines.

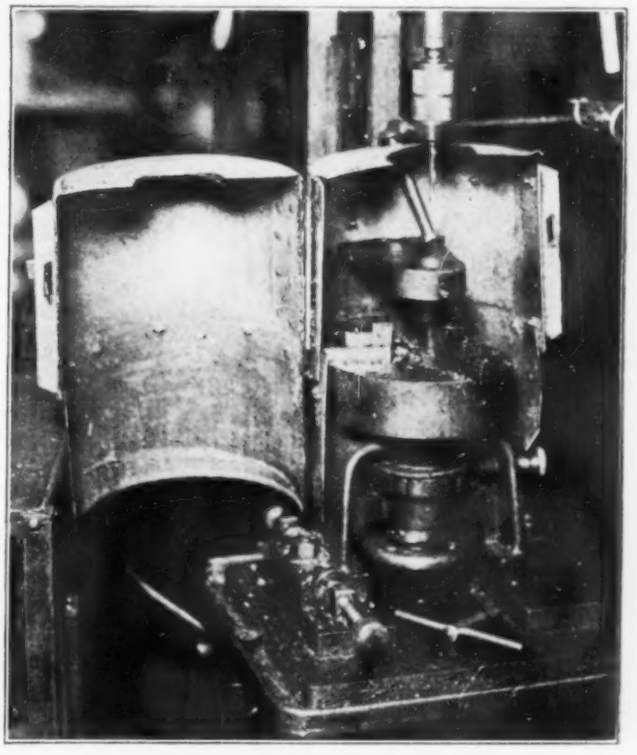


FIG. 12. OIL GUARD FOR DRILL

An example of such a casing is shown in Fig. 12 where a cylindrical casing completely incloses a drill, chuck and products while the drill is at work. This hollow cylinder is split vertically into halves hinged together so that the outer half may be opened wide when the operator is setting up the work. The casing is snapped shut as the drill is started and the oil turned on. The oil is led into the trough of the table of the machine and back to the oil well.

A simple guard designed to keep the oil of a pulley from flying on a desk immediately behind the pulley is illustrated in Fig. 13. This is merely a sheet of metal bent into the proper curve to loop partly over the wheel and prevent the oil from flying out either horizontally or vertically. Passersby are prevented from bumping into the pulley or the guard by a pipe fence.

Machines that do not need an entire casing around them can be protected where necessary by shields or aprons which may be attached to the machines permanently or may be detachable and adjustable. For the front of the machine the detachable style of apron is usually better. It is generally a flat piece of sheet-metal with the corners turned over and bound so as not to be sharp. Near its lower edge it has two strap-iron fingers riveted on. The sheet-metal fits against the inside of the lip of the bed or table of the machine and the fingers slide down on the outside. This apron

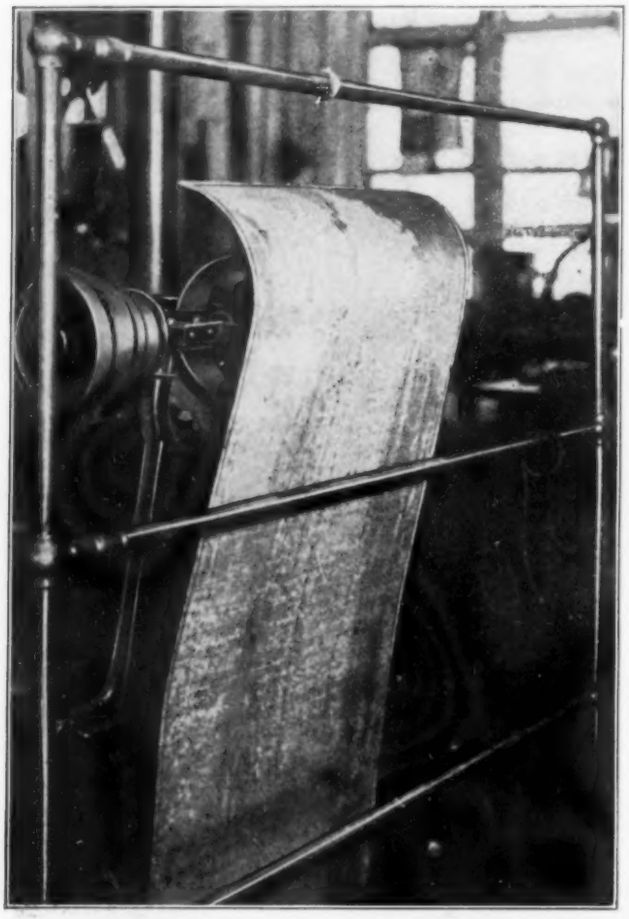


FIG. 13. OIL SHIELD FOR PULLEY

can be slid along the edge of the table to enable the workman to get at the product, and then slid back again, or it may be slipped off entirely to clean the machine.

Neatness is one of the first requirements of efficient arrangement. This is illustrated in the galvanized-iron trough which runs along the front of the four-spindle drilling machine in Fig. 14, and is divided into three compartments. A sheet-iron partition across the trough a short way from the right end is soldered in and made water-tight. The compartment thus formed is used as a well for the cutting fluid which flows off the bed of the machine and drops through a hole bored in the cast-iron trough. Each time a jig is opened and the product taken out, the jig is dipped in this well of cutting fluid and thoroughly washed before having the next piece of work inserted, thus keeping the jig free from chips, which might cause an error in the location of the work and spoil it.

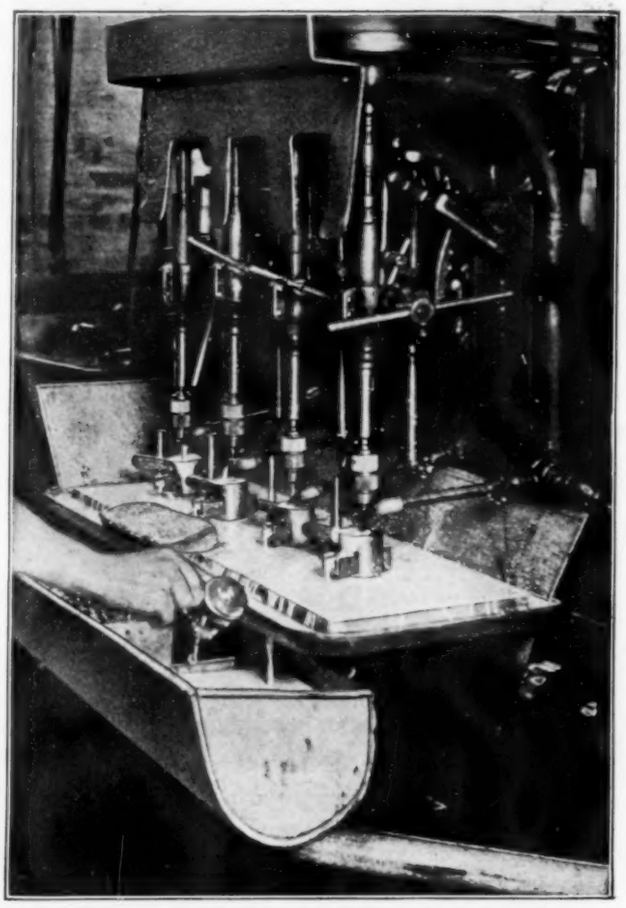


FIG. 14. TROUGHS AND GUARDS FOR MULTIPLE DRILLING MACHINE

In the trough next to the well is a small box with perforated bottom into which the product is emptied from the jig. The cutting fluid drains off and the work can be emptied at any time or inspected. In the farther end of the trough is another sheet-metal pan for holding the blank products. With this arrangement the operator has all his work directly before him and can operate the four spindles to their full capacity.

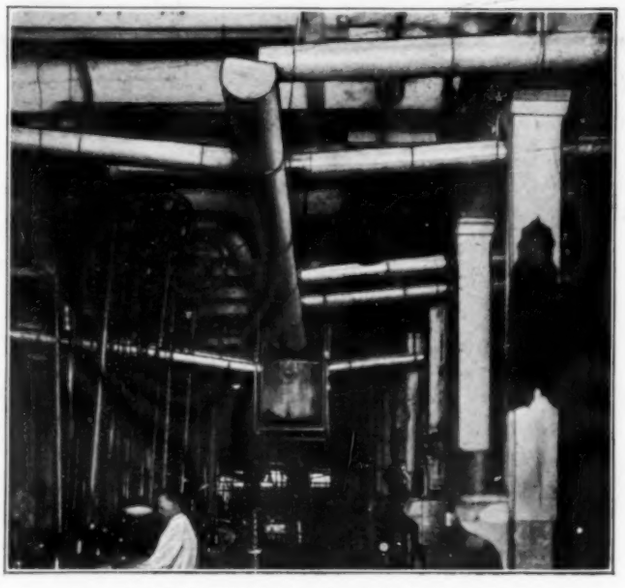


FIG. 15. OIL-COLLECTION SYSTEM

In the photograph of this machine will be noticed two of the adjustable aprons spoken of, one in the rear and one at the farther end. They are neat in appearance, rigid and effective.

At the top of this same figure may be seen an additional safeguard which was put on when women came to work in the factory of the Greenfield Tap and Die Corporation and were taught to operate machines of this sort. A sheet-metal guard is bent as shown to protect a woman's hair from being caught either in the belts or in the revolving spindles of the drills as she bent over to look at the work. Preventing the first strand of hair getting blown into a revolving part and twisted around until it secures a dangerous grip on the girl obviates most of such accidents.

Fig. 15 illustrates a system for collecting cutting oil and cutting fluid from the machines on the floor, which was put in to replace a system made up of steam pipes. The trough is shaped like an eave spout, is 6 in. in diameter and is supported by U-shaped hangers screwed to the beam above. One trough is run underneath each line of machines, and from each machine a hose comes down through a hole in the floor and discharges into the trough. All the branch troughs discharge into a central trough along the middle of the room, which in turn discharges into a tank suspended on a framework near the ceiling. The oil and cutting fluid are taken from this by a detachable pipe into a separator in the cellar. With the old system chips would block up either the branches or the main at least once a week. The riser then had to be taken apart by pipe fitters, cleaned out and put together again. The job cost $30 every month, as it took all day.

With the open troughs the cleaner can put a ladder against the trough, climb up with a brush or semicircular piece of sheet iron shaped to fit the inside of the pipe and brush whatever chips there are in the trough along it into the main trough and there clean them all out into a basket or pail. One man can clean out a trough in five or six minutes and the whole system needs only one man for a few hours instead of a gang for an overtime Sunday.

The best pitch for the side trough is at least one in ten, while that for the central trough should be a little more. This pitch will carry the chips along. There should be enough side troughs so that the pipes leading down from the machines can be nearly vertical to prevent dogging.

A good illustration of an exhaust system in a polishing room is shown in Fig. 16. It will be noticed that the main starts small at the near end, that is at the first machine, and grows larger as it goes on taking in branches from the other machines. The polishing wheels are 16 in. in diameter and to carry the necessary draft a 4-in. branch goes into the main from each machine. The proper size of the main at any point can therefore be figured from the number of branches which have come into it. The rule is that the diameter varies as to the square root of the number of duplicate feeders. For example, a main at the point where four feeders have come into it should have twice as large a diameter as where there is only one.

The near end of the exhaust system has a cap clean-out end instead of being permanently closed. This cap is made of a band of sheet metal several inches wide and is of a circumference to give a snug fit over the pipe

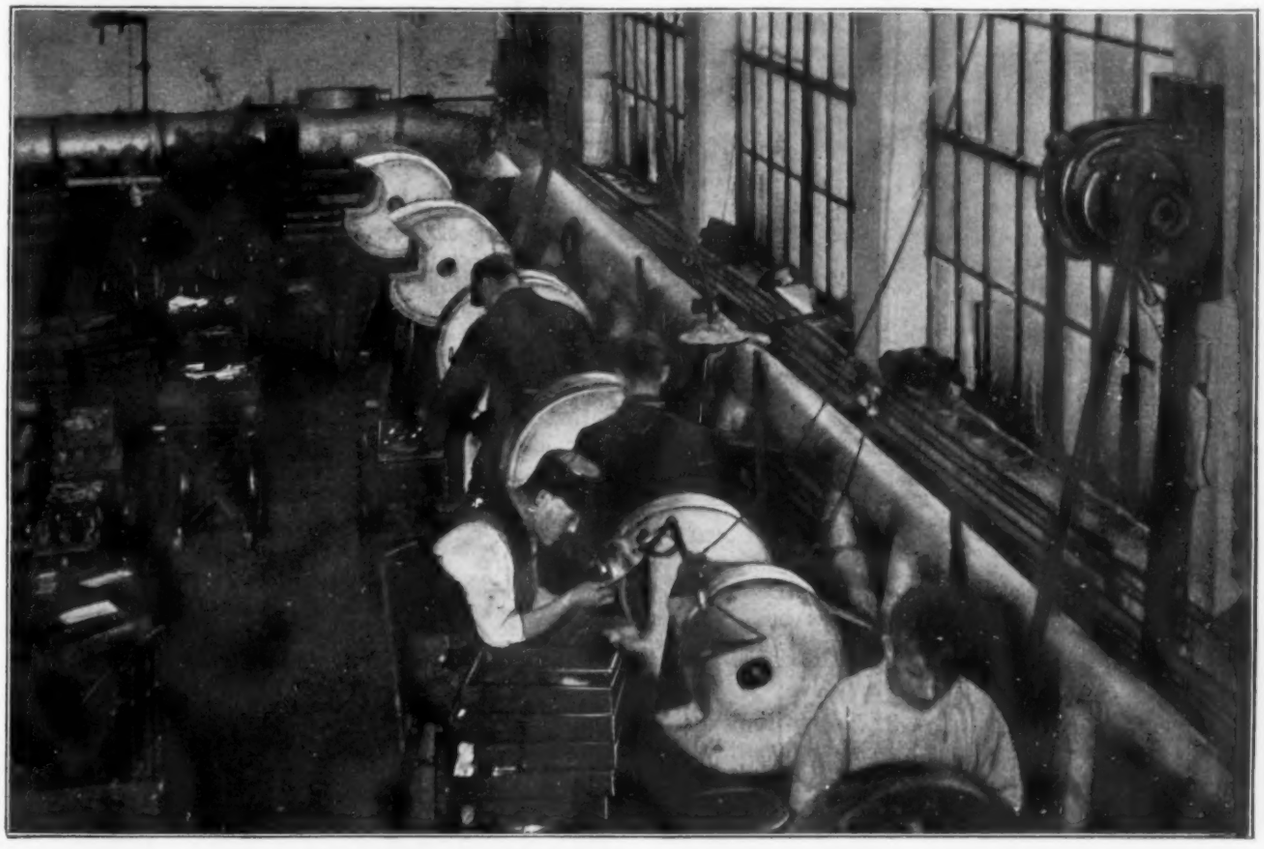


FIG. 16. FACTORY EXHAUST PIPING SYSTEM

itself; it also has a disk soldered over the end to close it. If the pipe becomes plugged or dirty the cap can be quickly twisted off by hand and a long rod run into the straightway of the pipe. Since the cap is on the extreme end of the pipe the suction tends to hold it on and there is no danger of it accidentally dropping off even if it were loose.

How to Make a Cleanout

Other cleanouts may be put in either when the line is first designed or afterward when experience has shown where they are required. To make such a cleanout, cut a circular hole in the top side of the pipe as big as is necessary to insert an arm or a cleaning rod. Then make a covering band of sheet metal out of a strip just long enough that when the two ends are bent upward at right angles they will not quite come together around the pipe. When the two upright lugs are drawn together by bolts the band will tighten around the pipe so snugly that it becomes practically a part of it. If the lugs are made right the bolts can be loosened when it is necessary to get at the cleanout, and the band may be slid along the pipe out of the way while the work is being done.

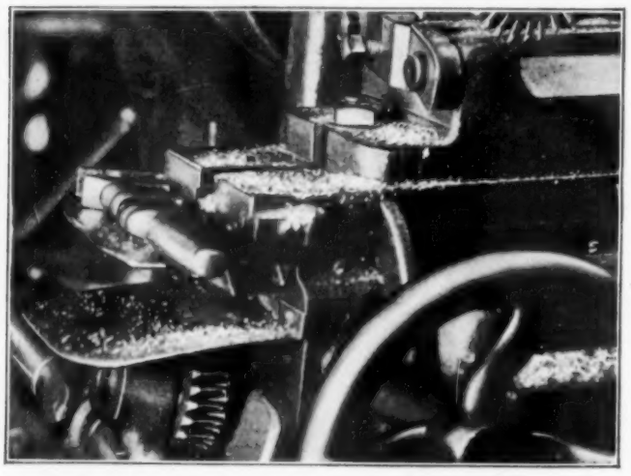


FIG. 17. SHELF TO PROTECT GEARING FROM CHIPS

The large dust-exhaust main leads into an exhaust fan at the center of the room which discharges the dust into the raceway running under the factory. The section shown is only one part of the system for the room, which is one of four in the factory which discharge at different points into the raceway. One of these systems, in order to reach the raceway, comes up over the roof of another building. The whole system was built by the factory's tinsmith at less cost than having the work done outside, the big riser and elbows having been built for $500 including material and time.

Miscellaneous Small Accessories

A tinsmith is most at home when he is making things that nobody ever made before. In a factory his opportunities for turning out handy aids to production are almost unlimited. For instance, from the milling machine in Fig. 17 chips used to fall into the mesh of a worm and wheel. Gears were broken and had to be replaced or the machine was stopped until the gears were cleaned out, thus delaying production. It was found that a small sheet-iron shelf bolted to the machine above the gears protected them from most of the chips.

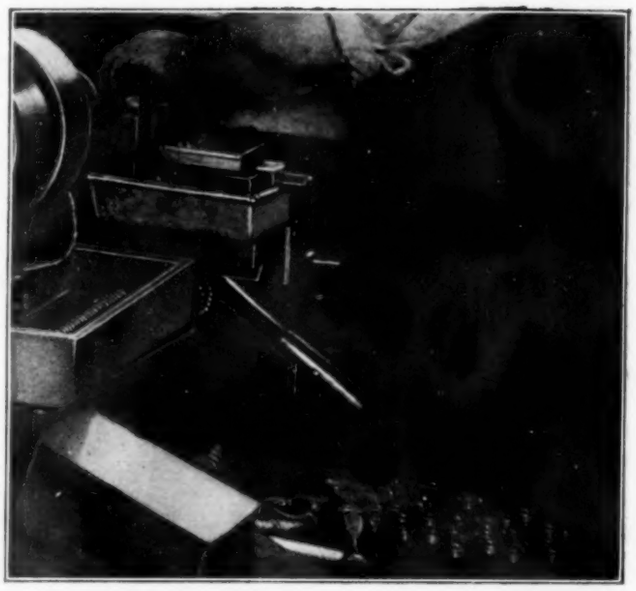


FIG. 18. SCOOP FOR PICKING UP SMALL PIECES

Similar small shelves can be bolted to machines at the handiest point on each to hold a gage or wrench. These are not only of theoretical value but are of real service to the operator. He soon gets accustomed to reaching to that one point for the proper tool and so instinctively uses it. It is highly advisable in instructing a workman in the use of gages to supply such a place for the gage at the nearest possible point to the work, so that the necessity of reaching for the gage will not deter him from using it as often as he should. He will soon get into the habit of using it on every piece if he loses no time thereby. This is a practical example of applied psychology which has been successful in the shop.

Scoops or Pans for Small Work

Small scoops or pans made to fit the table of a machine are found handy in dealing with small work. Usually the operator has to reach for a handful of small pieces and if his is the third or fourth process he is apt to get chips into his fingers or to be cut by a bur. If, however, he is supplied with a small pan turned up at

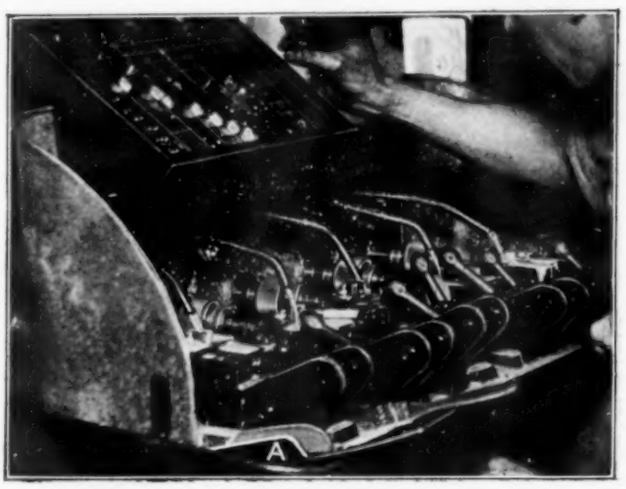


FIG. 19. SCOOP OR SHOVEL FOR CHIPS

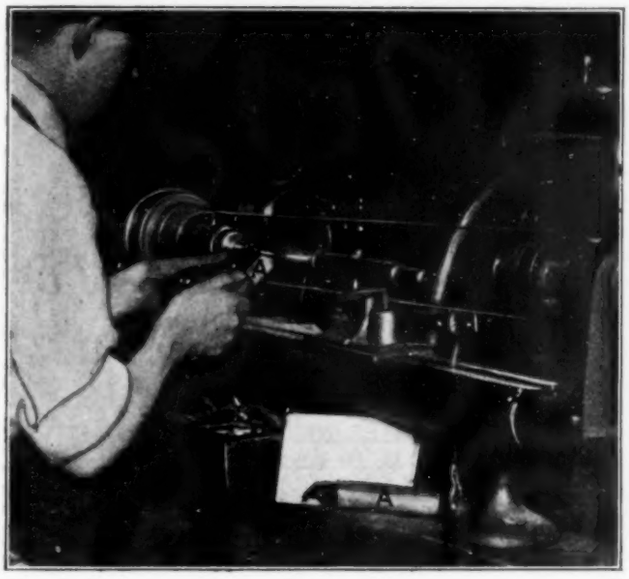


FIG. 20. SUPPORTING TOOL TO SAVE FINGERS

the edges as shown in Fig. 18, he can scoop up a sufficient supply out of the big supply box for several minutes' work and place them on his machine. From the small pan he can handle them so carefully as to avoid injury. The scoop or pan should be of such size that it will fit on the table or rest of the machine without projecting over the edges enough to get knocked off. Small shovels or scoops can also be used to pick up chips from the bed of the machine. These shovels can be of such a size that they will fit between the projecting parts of the machine like the one shown at *A*, Fig. 19.

How Tinsmith Can Make Small Tools For Holding Work

Small tools for holding work or to act as jigs may be made to order by tinsmiths for cases like the following: It was noticed that in holding a small cylindrical piece the operator had such difficulty in keeping his fingers from being injured that his work was slow as well as awkward. The factory tinsmith, observing the work, decided that the piece might continue to be supported at one end by the spindle center, as it was already, but that the other end could be supported by a small metal hook held up against it instead of by human fingers. He therefore cut a notch in a thin iron strap, split a short piece of broom handle in two for a handle, inserted the notched strip and bound the two halves of the broomstick together with a curved sheet of tin tacked round them. When this notch was held against the revolving piece of work as at *A* in Fig. 20, it supported it perfectly and not only saved the operator's fingers but released one hand so that he could reach for the next piece while the one in the machine was being done. He was able to work so much faster that the little holding instrument was improved to a permanent form.

In the same way many devices can be tried out in sheet metal, which is cheap and can be twisted into any shape. If the device works out well in this experimental form it can be made in steel or iron for greater permanance. Using sheet metal is also much quicker than waiting for a pattern and a casting or doing complicated machine work that one hesitates to do on merely experimental devices and might be greatly extended.

The tinsmith is also useful in making repairs. An instance of this is illustrated in Fig. 21, which shows the air-blast pipe on a heat-treatment oven. The blast enters through the 3-in. pipe, but a small hole was left near the base through which to light the oil and start the fire. The blast, however, was at such a height that it formed a back current of air at the bottom of the furnace, and after the fire was going blew back some of the oil spray out of the small hole. This caused a great deal of smoke and seriously reduced the oven temperature. The trouble was cured by running a small bypass into the small hole. This assisted the draft in the proper direction, blowing the oil back where it belonged and obviating the smoke.

All the tinsmith's work in this factory is done by one tinsmith, an apprentice and a helper. Of course everything he does is on order from the maintenance department, but sometimes such orders are not specific. One may come in on a formal blank but in quite informal language, such as: "Trouble with machine No. 1702. See if you can fix it." The tinsmith then sits down by the machine and lives with it. He questions the operator as to its workings, watches it and analyzes its movements. He finds out how the man works, what are his movements and the movements of the machine; how far they move, when and what movements are interlocking, what depend upon each other, where

FIG. 21. AUXILIARY DRAFT PIPE

spattering occurs, where the product strikes when it falls and how hard it strikes, where the chips come off, and the direction of the oil as it falls. Then he cuts and tries until he has his device adjusted to cure the given trouble.

Of course an order always comes from the maintenance department as a source, but as the tinsmith in wandering around sometimes sees a possible opportunity to solve a trouble there is nothing to prevent him from suggesting his solution first and getting an order for it afterward.

It is hoped that this article will be of benefit in drawing the attention of factory managers and maintenance superintendents, and even the engineering departments, to the uses that can be made of sheet metal.

"Jim"—Efficiency Engineer

By E. E. Watson

Apropos of recent discussions appearing in the columns of the *American Machinist* upon the subject of "efficiency" and "efficiency engineers," I want to tell you about Jim.

"Jim" was not his real name but it will serve for publication purposes, while the man himself will be immediately recognized from the description by the thousands who have come in contact with him.

Not so many years ago Jim and Jack started to work for the same automobile concern; Jim, owing to his superior education, as a clerk in the cost department while Jack went into the shop.

Jim advanced quite rapidly; in fact it was only a couple of years before he got a dollar or two more per week, while Jack was still chasing sky-hooks and looking after left-handed monkey wrenches at the same old figure.

About this time there dawned a new era in machine-shop management and all the boys bought dictionaries to study up on the new pass-word "efficiency." They could then make intelligent comparison between the rules as laid down by Webster, and the four or five specimens of the real thing that the old man had recently hired to tell him how to run the place.

Jack at first found the change quite welcome, as under the new conditions he was no longer required to go after the gookum oil every time a machinist wanted to polish the muchlen bar, but he soon found that this advantage was more than offset by his having to punch job tickets, and to put his number, age, general description and next of kin on sundry cards, signing same on dotted line, every time he wanted to get file handles, waste, oil, etc.

Contemporaneously with the new era there arrived in town one A. Hokus Pokus, the man who really founded the efficiency business, educated most of its experts, and was now in search of promising material for further efforts along the same line. To enable him more quickly to attain the desired end he forthwith opened up a school where ambitious young men could, in exchange for a considerable sum in coin of the realm, have instilled into their systems all the great underlying (accent the two last syllables) principles of scientific management.

Jim was very much interested in the literature which he received in reference to this school, and later met Mr. Pokus personally. This gentleman slapped Jim on the back and told him that only four or five years ago he, Pokus, had been nothing but an ordinary clerk in a factory office; but right there he stopped telling the truth and before Jim had gotten away he had signed on the dotted line and parted with the price of his next spring's suit.

In due time Jim graduated, and with the aid of a much beribboned and sealed diploma succeeded in landing a job as efficiency engineer in the forge shop of the Blankety Blank Corporation.

Way back in his childhood days Jim had "repaired" his mother's sewing machine—once—but from the time his mother caught him, up to the moment of his entrance upon his new duties, he had kept severely away from machinery of all kinds—the memories were too harrowing. Now one of the tenets of A. Hokus Pokus' teachings happened to be "always obtain competent counsel" and as the aforementioned company employed a real master-mechanic this fact automatically provided the competent counsel which Jim so much needed. In other words, the M-M. held down Jim's job for him—for awhile.

The Blankety Blank Corporation was suffering from a shortage of help. Good steam-hammer men were scarce and crippled equipment correspondingly plenti-

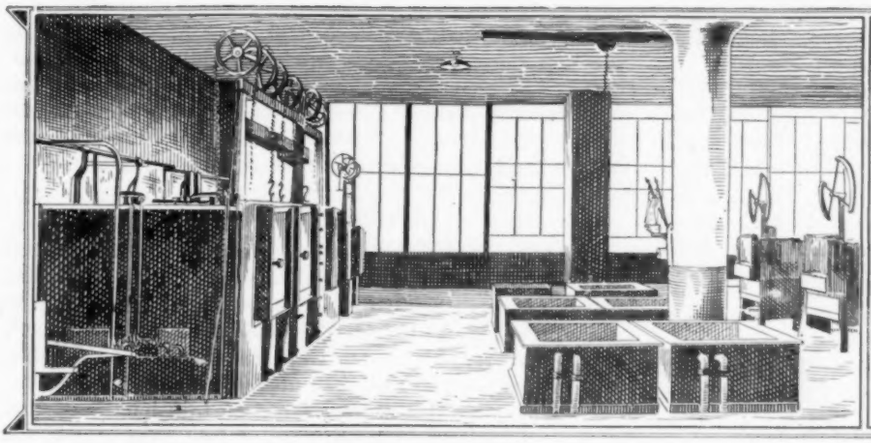
ful. Broken piston rods became quite too common and Jim was assigned to the job of applying the remedy.

Straight to the office of the master-mechanic went Jim, to take counsel. That official carefully explained to him the theory and construction of steam hammers, that lack of alignment coupled with the inflexibility of the average piston rod was probably the cause of the breakage, and artfully suggested that Jim, with the help of his glittering diploma and one of the draftsmen, could probably design a piston rod with a knuckle joint in it that would enable the ram to glide gracefully around any curve that the guide ways might assume—just like an express train on a railroad track.

Jim saw the point—was he not getting the benefit of competent counsel?—and by virtue of his authority as efficiency engineer prevailed upon the drawing office to put this scheme on paper.

In due time a wonderfully ornate blueprint bearing Jim's name in six places as the designer of the now famous flexible piston rod was laid before the superintendent.

The superintendent is a man of few words but on that occasion those few were carefully chosen. Jim is now a clerk in the cost department of the Old Times company.



HEAT TREATMENT of ALLOY STEEL

By
K. A. Juthe
CHIEF ENGINEER—WHEELOCK, LOVEJOY & CO.

Heat-treatment has always been clouded with more or less mystery to the average man who is not directly connected with it. In this article the author, who has had wide experience, gives many practical points and suggestions which will be of value to those who desire to become more familiar with this work.

THE heat-treatment of steel can be classified into two distinct groups: First, that which includes the hardening and tempering of crucible steel, annealing, case-hardening and the relieving of strains from hardening or forging operations, and second, that which includes the alloys—steels which carry certain percentages of manganese, chromium, nickel, vanadium or other elements. The automobile industry is largely responsible for the last group, and the tremendous amount of research work which has been going on for the past few years on gun and ammunition requirements has added to the interest and knowledge of the subject.

The first group is so well understood by the majority of practical mechanics that I will consider only the second group as having the greatest interest at the present time. It is well to bear in mind, however, that the same principle underlies all steels, no matter what the percentage of carbon may be, and even the so-called tool steels are all made with one or more alloys.

The purpose of heat-treatments for the alloy group is to increase strength and toughness of material and at the same time to increase machining ability by leaving steel ductile. To properly heat-treat steel we must know the composition of steel and at what degrees of heat changes occur.

The Properties of Iron

From text books we know that iron possesses the allotropic property of existing in three different conditions and still remain the same chemically. If we heat pure iron to 1390 F. it suddenly loses its magnetism and instead of being soft and ductile it becomes hard and brittle. If we continue to heat it until it reaches 1635 F. it again suddenly changes its properties and instead of being brittle becomes again ductile, but still hard and nonmagnetic.

These stages of iron are called respectively:

ALPHA iron, soft and ductile and stable on lower critical point;

BETA iron, hard and brittle, stable between critical points, and

GAMMA iron, hard and ductile and stable above high critical point.

Now if carbon is added to the iron the critical point is lowered in direct proportion to the percentage of carbon until the point of calescense is reached. In carbon steels this is about 1350 deg. Fahrenheit.

The composition of steel is given by Prof. Albert Sauveur, as follows:

FIRST, FERRITE, which is pure iron, low in tensile strength but very soft and ductile;

SECOND, CEMENTITE, which is a carbide of iron, present in steel of over 0.9 per cent. carbon, very hard and brittle, and

THIRD, PEARLITE, which is simply a mechanical mixture of pure iron with cementite.

Pearlite is present in steel in increasing percentages up to 0.9 per cent. carbon, with a corresponding decrease in ferrite. At 0.9 per cent. carbon the steel is all pearlite. When the carbon is over 0.9 per cent. the pearlite decreases in percentage with a corresponding increase of percentage of cementite.

The Conditions of Steel

Every condition of heat on steels, from the low critical point to that above high critical or overheated steel, has been recorded by numerous authorities on the subject. I will briefly touch on these not because of any actual value to the operator, but simply to show that a difference of a few degrees in heating gives a different structure of steel easily recognizable in a microphotograph.

OSMONDITE appears at about 750 deg. when cementite begins to dissolve in Alpha iron;

SORBITE appears at 1100 deg. F., and is nearly all pearlite, but with a certain percentage of cementite undissolved;

PEARLITE is thoroughly saturated Alpha iron with cementite;

TROOSTITE is the higher carbon steels in tempered conditions;

MARTENSITE is properly hardened steel, and

AUSTENTITE is present in high-carbon overheated steel.

Supposing a demand is made on a steel mill for a certain quality of steel—From the laboratory diagrams and reports of a certain combination of elements can be selected, the proper percentage of each figured out

and steel can be made for so much a ton. Beautifully simple, but let us see how it works out.

The first consideration is that the manufacture of a great number of alloy steels and their heat-treatment are still in their infancy in this country. Steel manufacturers of this country have been forced into a regular whirlpool of specification requirements and demands of all kinds during the past few years to such an extent that our laboratories, colleges, chemists, etc., were taxed beyond capacity to furnish data. As an example, take the requirement for gun steel.

Difficult Specifications

Suddenly requirements came for several million guns to be made at once. Specifications from a foreign government were such that no mill in this country could or would furnish material. If we had been able to manufacture the steel no one would have had the proper facilities for heat-treating nor the knowledge to heat-treat such steel to the requirements demanded. Take for example the following:

Elastic Limit	Tensile Strength	In 2-In. Elongation	In 2-In. Contraction
90-100,000 lb. per sq.	125,000+	18+	40%

Not only did the specifications give us the physical properties wanted but they also gave us the analysis from which we were to develop these properties. Here are the specifications:

Carbon	Tungsten	Silicon	Sulphur	Phosphorus
0.60	1.0	0.20	Not over 0.02	Not over 0.02 Only trace of other elements

On top of these specifications the manufacturers of the complete guns had a specification of their own which reads:

"All heat-treated steel *must* possess the quality of easy machining."

This steel referred to practically pure Norway iron base, with its alloy tungsten added, which it would have been next to impossible to get at any reasonable price in such quantity as wanted. It would also have to be made either in a crucible or in electrical refining furnaces, and the whole proposition was hard to figure on.

Finding a Substitute Steel

The next proposition was to substitute a steel at a reasonable price which under heat-treatment would meet the physical and mechanical requirements. It was my good fortune to have this particular requirement put up to me for solution, and I will outline the proceedings step by step that solved this problem in the hope that it may assist others.

By looking up our regular charts and records we found a steel formula to give us the following:

	Elastic 75,000	Tensile 110,000	Elong. 20	Cont. 45%
Carbon	Manganese	Silicon	Sulphur	Phosphorous
0.50	1.10	0.15	0.06	0.08

How to increase the elastic limit and keep the elongation or ductility high at the same time was the problem. If it had been only to increase strength without regard to elongation or machining qualities it would have been a simple matter, as increasing the carbon content would have been sufficient.

Some foreign element, or alloy, had to be added to ordinary steel to meet the physical requirement and still after heat-treatment show a grain of all pearlite. In other words, we required a thoroughly saturated steel to which had been added the necessary degree of toughness to meet requirements and which also showed the needed ductility for excellent machining. By adding the manganese contents, and also adding a small percentage of chromium and nickel we could easily reach physical requirements, but we could not under our ordinary heat-treating methods keep it uniform and secure the ease of machining which was necessary.

Making the Tests

A series of tests were then made. Hardening heats from 1350 to 1650 deg. F. varying by 25 deg. were taken, all being heated exactly the same length of time and quenched in oil at the same temperature of oil. Microphotographic plates were taken so as to find the saturation point. The rest of the bars were then put into tempering furnaces, given a certain length of time at a certain temperature, when a few were pulled out from each hardening heat and buried in lime. Tempering was started at 900 deg. F. and went by variation of 10 deg. until we reached 1350 deg. F. when the remainder were pulled out and buried in lime.

It will be noticed that hardening was started at the critical point of steel, 1350 deg. F., and also that the tempering was stopped at the same critical point. This was for the reason that no changes would take place in this grade of steel below the critical point in hardening, and if tempered above this temperature, the unstable condition would be reached.

Another batch of test pieces was immediately started. This we made from steel 5 points lower in carbon and 10 points higher in manganese, the other elements remaining the same. These were hardened and tempered as before, every piece of course being properly marked. We kept this up until we had determined the proper condition of steel to meet all the requirements wanted. The fact was thus established that any modification of analysis in any of the elements, except that of sulphur and phosphorus, makes a change necessary in the hardening heat, in the length of time of the heat, in the temperature of the cooling compound (generally oil), in the heat of the tempering and in the time the steel was left at high heat, as well as the time allowed for cooling.

For heat-treatment of parts on which all the machining has been done and which simply require grinding to finish a great deal of work on the steel can be saved as the condition of saturation does not make so much difference. But where fine machining is to be done afterward, segregation must be avoided, as well as hard spots, soft spots, ghost lines, cold checks caused by cooling too quickly after tempering and strains caused by careless heating in tempering or by careless burying after tempering.

We can now take up the elements which determine the transformations in both hardening and tempering. The question naturally arises as to the need of first hardening such steel and then tempering until it becomes ductile.

The reason is that after the steel solidifies after pouring, it cools very rapidly from its liquid state, thereby causing segregations (the ferrite and cementite do not have time to get together), stress, etc. In reheating we bring it beyond the upper critical point to Gamma iron, that state wherein the condition is stable. Quenched from this temperature the molecules remain in the right crystalline form, so that a slow tempering process can finish the work and deliver a perfect sorbitic or pearlitic saturation, as we may desire.

The effects of some of the components and alloys of steel are of great interest and should be noted.

Carbon is, as far as the steel referred to here is concerned, the controlling factor in determining the critical point. In other words the hardening temperature is determined by carbon content.

Manganese of 1 per cent. (100 points) or more controls the time of soaking at high critical point.

High silicon will shorten the time of soaking somewhat, but low silicon will not increase it.

Chromium, if present to the amount of over 5 points, will add 1 deg. F. to hardening heat as predetermined from carbon for each point of chromium. For instance, if the predetermined heat is 1500 deg. F. and steel to be hardened contains 1 per cent. (or 100 points) chromium, add 100 deg. F., making the critical point 1600 deg. Fahrenheit.

Nickel to the extent of over 10 points will add approximately 1 min. to the soaking time for each point present up to 50 points. If over 50 points both hardening and tempering heats will change.

For tempering, however, a different process is carried out for the determination of the factors involved.

Carbon we practically eliminate, as no martensite condition exists at a heat of 700 deg. F. and over.

Manganese has done its real work, keeping a sort of fibrous grip on the molecules in suspension.

Silicon, in conjunction with sulphur and phosphorus, acts as a lubricant and facilitates the relocation of the saturated mass from one of rigidity to one of ease. Too much lubricant is just as bad here as in high-speed engines. It will prevent the proper binding of molecules together and weakens the structure, but all three are a great help to machining operations. Sulphur should not exceed 0.07 and phosphorus 1 per cent.

Chrome and nickel control both temperature and time in direct proportion to their percentage. When chromium is present at 1 per cent. or more and nickel at 3 per cent. or more, singly or combined, they present a problem not as yet solved by heat-treatment experts. They are most difficult to treat with any certainty of uniformity as far as ease of machine operations is concerned.

Functions of Different Elements

We can sum up the different elements in ordinary alloy steels to have the following functions: Carbon for hardness and rigidity; manganese for toughness; silicon a sort of adjuster; sulphur and phosphorus as lubricants; chromium as a refiner of grain and to add hardness to help carbon; nickel as a protecting support of structure and as an aid to stability, and vanadium in small doses acts as a scavenger, in high percentage it is a great resister of friction.

In heat-treating alloy steel there are certain factors to bear in mind. These factors may vary slightly as to the duration of heat limits, but they are always present, and the following points must be considered:

First, one must know the critical points.

Second, one must not fall below high critical point when soaking steel.

Third, steel of the same analysis must have the same length of time for soaking to give uniform results.

Fourth, quenching must be done within certain limits of temperature, depending on the quality of the work performed, or uniform results cannot be obtained.

Fifth, tempering heats vary on a 10-deg. F. basis; very close heat limits must be established for the quality of work desired.

Sixth, a low limit must be set as to the time necessary for soaking at high heat. This heat must not fall below the heat wanted while being soaked, for if it does, the timing must begin when this temperature is again reached. Too long soaking may cause a reaction, giving a dry steel with a great drop in elastic strength.

Seventh, when taken out of the furnace the work should be buried in lime and thoroughly covered with no chance for air pockets. Air-cooled steel will contain hard spots on the surface and soft spots in the interior. If no information is at hand as to the critical points of steel they can very easily be ascertained by pyrometer or magnet methods.

The Calescent Point

The calescent point can be determined by use of the pyrometer by closely watching its needle. The thermocouple, or fire end should be inserted in the steel. Drill a hole in the piece to take in the fire end of thermocouple. As the heat advances the needle will follow until it reaches a point where it suddenly stops, wavers and then suddenly drops several degrees, although the heat is constantly advancing; then the needle will again suddenly commence its upward swing. Where the needle stops its upward swing and rests is the calescense, or low critical, point.

Now reverse the operation. Heat beyond the critical point and shut off the fuel and watch for the same phenomena. The needle will fall with heat, suddenly stop, then advance several degrees, when it again starts to drop for good. This upper change is called the recalescense point.

When testing with the magnet use an ordinary horseshoe magnet. Touch the steel with magnet during heating and at that temperature at which the steel fails to attract the magnet, or in other words loses its magnetism, that is the point of calescense, or critical, point.

Even Heating Necessary

Strains in steel are very often caused by having no heat circulation about the work, particularly when heating in furnace, by work being placed on the furnace floor. Circulation of heat is necessary, and the best method is to lay long pieces or strips on raised perforated platforms.

The furnace should be "balanced;" in other words, the heat must be evenly distributed; in fact several firing ends should be in the furnace at all times, connected by switch to the same pyrometer.

The cooling agent should be kept within very close temperature limits.

How Johnson's System Speeded Production

By John R. Godfrey

Johnson's faith in his new system, which has cost him days and nights of hard labor to say nothing of wads of cold cash, received a solar-plexus blow the other day. He had personally put through an order for a particular friend, for a special blowpipe, the chief feature being that the nozzle was to be bent a few degrees more than the regular pattern, this bending taking about seven minutes after the job was really in hand.

Knowing that time was apt to be lost sight of in

the way of orders, checks and other parts of the system he played safe by putting the shipping date three weeks ahead. Then he personally started the order through the mill, filling out the first blank and shooting it straight to the fountain where all good little orders get a proper start in life.

Then he promptly forgot it as he should knowing full well that on the 29th of February the aforesaid blowpipe would be in the hands of his friend.

Imagine his surprise a few days later to get a red-hot, sarcastic letter from this self-same friend reminding him of his new system, and then asking when he might perhaps be permitted to gaze upon the aforementioned and much-desired blowpipe. He had been notified of its shipment but couldn't trace it.

Johnson was hot. He grabbed the 'phone and called the foreman of his blowpipe department, a man who had been with him for years and on whom he could bank every time to get work out.

"Jack, what about that special blowpipe for my friend X? Order went through three weeks ago. Put it through myself. When did it leave your department?"

"Never had such an order, Mr. Johnson. No such order has come through this department."

"It hasn't? Well where in helenblazes do you suppose it is? How long would it take for you to get it ready for shipment after you got such an order, Jack?"

"Not fifteen minutes, sir. I'd just take a standard blowpipe from the lot going through and bend it to the angle he wants. You get me the order and you can send for the pipe in fifteen minutes."

A Little Sherlock Holmesing

By this time Johnson was getting cagey and he thought he'd try a few practical experiments on his new system. So he called the shipping department.

"When did you ship that special blowpipe to X?"

"February 28th, Mr. Johnson," replied the clerk, looking up a shipment schedule.

"And did you notify them the pipe had been shipped on that day?"

"Yes, sir—always do so."

"Well, where in thunder did you get the blowpipe to ship? Jack says he hasn't made it yet. What's the use of records that record what you *ought to have done* but not what you did? The order for that pipe hasn't reached the shop and you notified the customer it's been shipped just because the schedule said it was to be ready that day. Darned if I know which is the bigger jackass, you or the system."

Then he started on a still hunt. He found the order finally, dusty and somewhat begrimed. It had gone from the shipping clerk back to the engineering department for engineering investigation. Someone had discovered that the old man—that's Johnson—had written "copper" tube when he meant brass. Hence it had to go back again to one of the departments and start all over again.

The only trouble was it didn't start. It got sidetracked and was in the basket of one of the many clerks who formed a part of the system. It had also gathered unto itself various kinds of orders and notations. It would seem as though every systematizer was a stockholder in a paper mill and a carbon-paper establishment. Reams and reams of forms, carbon copies, etc., etc., seemed to be the first thought.

By the time Johnson had found the order he was not in the best of temper, even though he is a mild-mannered man in most cases. He was just getting ready to go to the stockroom and take a blowpipe by force if necessary, and take it over to Jack's department to fix it as X wanted it. But before he could put this determination into action the office boy came in with the desired pipe.

"Where the deuce did you get that, Johnnie?"

"I heard you talking and guessed you wanted one pretty bad. So I went downstairs to the stockroom, walked in, picked this up and walked out again. Jack thought you'd sent it and fixed it for me himself—told me to send him the order later to keep his records straight. And here it is, sir. You aren't mad, are you?"

"No son, I ain't mad. I'm darned glad some one in the office has a little pep. The system evidently doesn't hinder you, or anyone, from grabbing what he likes out of the stockroom, but it sure does block an order from going through in the regular way.

"I've heard of systems that told you what you should have done the week before, and I guess I've got it. Son, you stick around the office and keep your eyes peeled as you've done today and you won't be sorry."

Using the Compound Rest for Accurate Tool Setting

By Joel Sundell

A compound rest equipped with micrometer dial may be used for making extremely minute adjustments by merely swiveling it to any ratio desired, for instance:

If it is set at 45 deg., one 0.001-in. division on the dial will advance the tool 0.0005 in. or remove 0.001 in. on diameter of work. If set at 30 deg., the tool advance will be 0.00033 in. and if set at 50 deg., 0.00005 in. The following is the formula:

A = Advance of tool.
B = Amount removed on diameter of work.
C = Number degrees of set over of compound rest.
D = 90 deg.
E = 0.001 division on dial.

$$A = E \div \frac{C}{D}$$

$$B = 2A$$

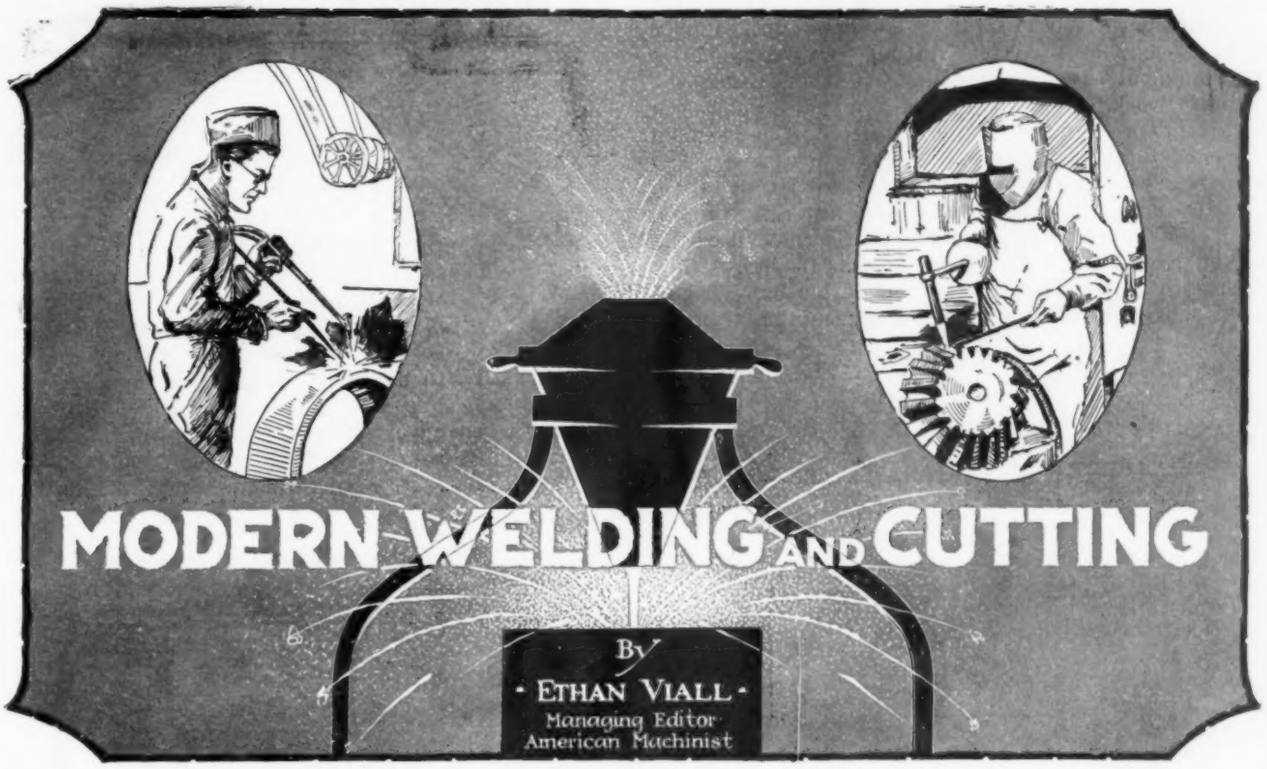
$$C = D \div \frac{E}{A}$$

How Would You Prevent Oil From Discoloring Finished Surfaces?

By J. H. Gravell

In answer to the above query, printed on page 802 of *American Machinist*, I would suggest the following method which I have used with success:

Wipe off the old oil, softening it with kerosene if it has become hardened; apply Deoxidine with a brush, allowing it to remain on the surface about two minutes, and then wipe the surface with a clean dry cloth. Let the surface thoroughly air dry for about two hours and then apply a light machine oil. Deoxidine is made by the American Chemical Paint Co., Philadelphia.



XIII. Gas Cutting Torches

The heating part of a gas cutting torch differs but little from that used for welding, except that, as a rule, the jets are multiple. The principal difference lies in an added jet of oxygen which does the "cutting." The various makes of gas cutting torches are here shown in detail in order to make clear their interior construction.

THE gas cutting torch is commonly used for cutting through various thicknesses of steel or wrought iron, which are the only metals which can be satisfactorily or economically cut by this process. Cast iron cannot be cut with a gas torch. As an adjunct to a welding outfit, the cutting torch is used for beveling and for cutting out patches and holes. The process is based on the fact that a jet of oxygen directed upon a previously heated spot of iron or steel, causes it to ignite with the result that the metal, acting as its own fuel, burns away rapidly in the form of iron oxide. This oxide runs, or is blown, out of the cut or kerf produced, in a stream, provided the torch is fed along properly. The same sources of gas supply may be used as for welding, though in some cases other regulators must be employed.

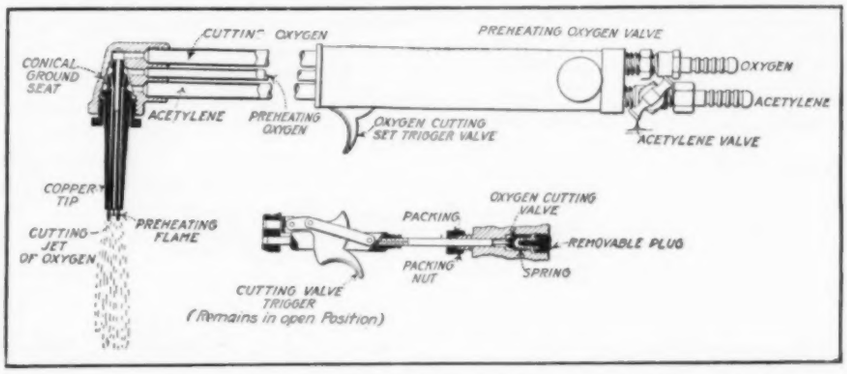


FIG. 129. DETAILS OF THE DAVIS-BOURNONVILLE CUTTING TORCH

As previously stated, steel and wrought iron are the only metals which can be satisfactorily cut by this process. The reason is that these two metals combine readily with oxygen, with the liberation of heat. The slag is produced at a temperature below that of the melting point of the metal, with the result that it is easily separated from it. Other metals do not produce so much heat when combining with oxygen, and the oxide formed is not reduced to a molten condition at temperatures below that of the melting point of the metal, with the result that it cannot be easily separated.

The combination of the oxygen with the iron is not that of complete combustion. An examination of the slag produced shows the presence of metallic iron, which leads to the belief that the oxidation follows the grain surfaces of the metal and more or less mechanically disintegrates the mass at the line of cutting.

There are two kinds of cutting torches used, known as the central and follow-jet types. The central type has a number of heating flames surrounding a central hole from which only oxygen issues. The follow-jet type consists of one heating jet and one following-oxygen jet.

*For the author's forthcoming book, "Welding and Cutting."
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Since the temperature to which it is necessary to heat the iron or steel, in order to have the oxygen act, is comparatively low (about 900 deg. F.) a number of gases may be used for heating. Oxy-acetylene is very commonly used on account of its convenience, for ordinary work. For heavy work oxy-hydrogen is used on account of its longer flame and because no products of combustion that hinder cutting are produced. The temperature required is well within its heating range, and steel up to 36 in. thick has been cut. The thicker the metal the greater the pressure of oxygen used, as will be seen from the various tables. In the cutting torches, the holes for the various jets are usually drilled in the same tip, though in some cases separate tips, set

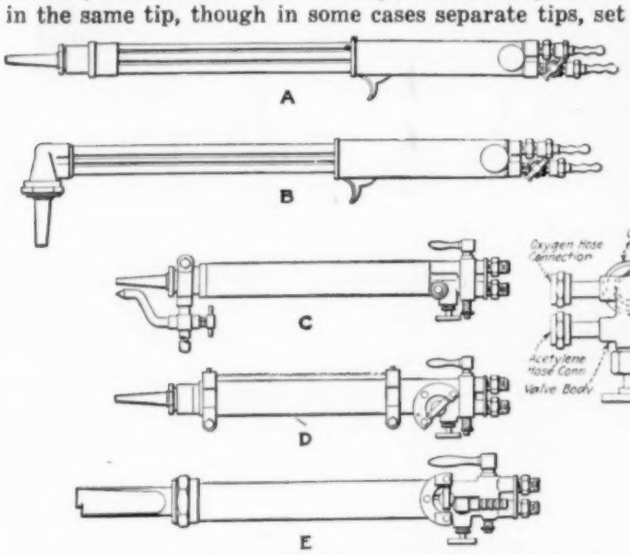


FIG. 130. VARIOUS MODELS OF THE DAVIS-BOURNONVILLE CUTTING TORCHES

close together, are used. The ordinary cut or kerf made by the cutting torch is from $\frac{1}{16}$ to $\frac{1}{8}$ in. wide, according to the size of the oxygen jet used.

Since the same construction of the heating part of a cutting torch is used as in the welding torch, it naturally follows that both the positive-pressure and low-pressure, or injector types of heating units are used in conjunction with the single oxygen cutting jet.

The Davis-Bournonville Cutting Torches

The details of a Davis-Bournonville, No. 3000, cutting torch are shown in Fig. 129. This is typical of the

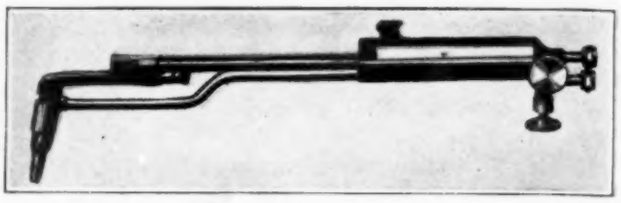


FIG. 132. THE OXWELD CUTTING TORCH, MODEL B

general principle on which all of this firm's cutting torches are made. In use, the positive-pressure heating unit is first started and applied to the work to be cut. As soon as the metal reaches a red heat, the trigger is pressed and the oxygen jet commences its work. This particular model of torch is supplied with five interchangeable tips, and the cutting jet of oxygen may be turned on or off by a simple pressure of the trigger, as just mentioned. This trigger is so made that it is not necessary to keep the finger on it all the time

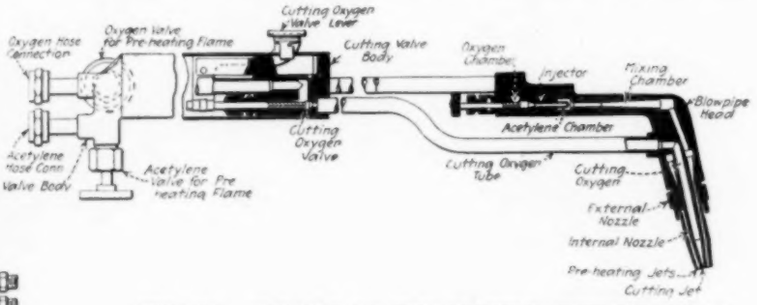


FIG. 133. DETAILS OF THE OXWELD CUTTING TORCH, MODEL B

it is in use. There are only two hose connections for the gases, one for oxygen and one for acetylene. The pressures of the respective gases vary with the thickness of the metal being cut, which may be from $\frac{1}{8}$ up to 12 in. or more. The torch is 20 in. over all, and is especially adapted to freehand cutting, and in wrecking or scrapping metal.

A number of different styles of cutting torches are shown in Fig. 130. *A* is a straight-head cutting torch (No. 2018) which may be fitted with curved tips for cutting boiler tubes, rivet heads, etc. Three bent and two straight tips are regularly furnished. In general, it closely resembles No. 3000.

The torch *B*, known as No. 1316, is very much like

STYLE No.	STYLE of TIP	ILLUSTRATION	SIZES	REMARKS	STYLE No.	STYLE of TIP	ILLUSTRATION	SIZES	REMARKS
7	OXY-ACETYLENE BOILER TUBE TIP	45°	1 2 3 4		674	OXYGRAPH CUTTING TIP		1 2 3 4 5	5 HEATING HOLES
10	OXY-ACETYLENE WRECKING TIP	30°	1 2 3 4		1511	REG OXY-HYDRIC CUTTING TIP		1 2 3 4	
12	REGULAR STYLE "C" CUTTING TIP		1 2 3 4 5 6 7 8 9 10	TWO HEATING HOLES	1567	LARGE OXY-HYDRIC CUTTING TIP		1 2 3 4 5	
15	OXY-HYDRIC HAND CUTT TIP		2 3 4 5	WILL CUT FROM 6" TO 16"	1568	LARGE OXY-HYDRIC BENT CUTTING TIP	30°	1 2 3 4 5	
16	OXY-HYDRIC MACH CUTT TIP		2 3 4 5 6	WILL CUT FROM 6" TO 24"	1678	OXY-HYDRIC CUTTING TIP		1 2 3 4 5	"ALCO"
25	STYLE "C" OXY-AC CUTTING TIP		2-1 2-2 2-3 3-1 3-2 3-3 3-4 3-5 3-6 3-7 3-8 3-9 3-10	4 HEATING HOLES	1967	CITY GAS TIP CHICAGO STYLE		1	INJECTION TYPE
26	STYLE B.C. CUTTING TIP		1 2 3	FOR BILLET CUTTING ONLY	2017	PANAMA CUTTING TIP		2	7" LONG 2 HEATING HOLES
29	MULTI FLAME B.C. CUTTING TIP		2		2113	STYLE "A" TIP		1 2 3	FOR CUTTING ATTACHMENT
35	STYLE "C" CUTTING TIP		4-1 4-2 4-3 4-4 4-5 4-6 4-7 4-8 4-9 4-10	FOR CARBO-HYDRIC CITY-NATURAL GAS	2133	OXI-HYDRIC HAND CUTTING TIP		2 3 4 5	"ALCO"
206	OXY-ACET. PL. CUTTING TIPS		2 3 4		2272	PANAMA CUTTING TIP		3 4	7" LONG 4 HEATING HOLES
207	OXY-HYDRIC PL. CUTTING TIP		2 3 4		2690	OXY-HYDRIC CUTTING TIP		1 2 3 4 5 6 7 8 9	G. E. CO.
208	OXY-HYDRIC BENT WRECKING TIP	30°	2 3 4						

FIG. 131. DIFFERENT TIPS FOR USE WITH THE DAVIS-BOURNONVILLE CUTTING TORCHES

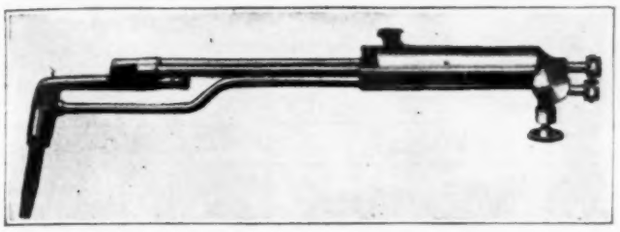


FIG. 134. THE OXWELD CUTTING TORCH WITH A RIVET HEAD-CUTTING NOZZLE

the first torch described, except it is intended for use with oxy-hydrogen. Torch *C* (No. 471) is a circle cutting torch fitted with a 15-in. radius rod adjustable for various sizes of circles. It uses either oxy-acetylene or oxy-hydrogen for heating, and takes all standard size tips. It is the standard torch for nicking billets for breaking. It may be had fitted with special adjustable

TABLE XVI. GAS PRESSURES USED WITH THE DAVIS-BOURNONVILLE STYLE C CUTTING TORCHES, USING STYLE 12 TIPS

Tip No.	Thickness of Metal Inches	Acetylene Pressure Lbs.	Oxygen Pressure Lbs.
1	1/8	3	10
1	3/16	3	15
1	1/4	3	20
1	5/16	3	20
2	1/4	3	10
2	1/2	3	20
2	3/4	3	30
2	1	3	35
3	1	4	30
3	1 1/2	4	40
3	2	4	50
3	3	4	60
4	3	5	60
4	4	5	70
4	5	5	85
4	6	5	100
5	6	6	90
5	7	6	100
5	8	6	125
5	10	8	150

holder, rack and pinion, for machine cutting. Torch *D*, No. 640, is a machine cutting torch for use with the different cutting machines made by the Davis company. It is fitted with an electric switch and shut-off valve which automatically starts the cutting-machine feed when the oxygen cutting jet is turned on, without the necessity of readjusting pressures or the heating flame. It uses all standard-size cutting tips and special Oxygraph and Radiagraph tips. A larger and heavier

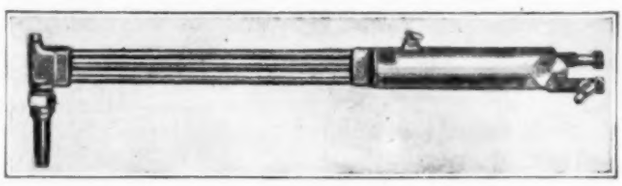


FIG. 135. THE OXWELD CUTTING TORCH FOR SHIP WORK

torch of similar design and construction for oxy-hydrogen machine work is shown at *E*. This is known as No. 1314. Larger sizes, or special torches used for cutting, are water-cooled. Tips of various styles, for different purposes, which may be used with the torches mentioned, are shown in Fig. 131.

The approximate oxygen and acetylene pressures used in the Davis style C cutting torches, using style No. 12 tips, are given in Table XVI. As in welding, these pressures are only general guides for the make of torch mentioned, and the skilled operator usually adjusts his flame regardless of the tables given, since a neutral heating flame is essential at all times for satisfactory results.

An Oxweld low-pressure or injector type of cutting

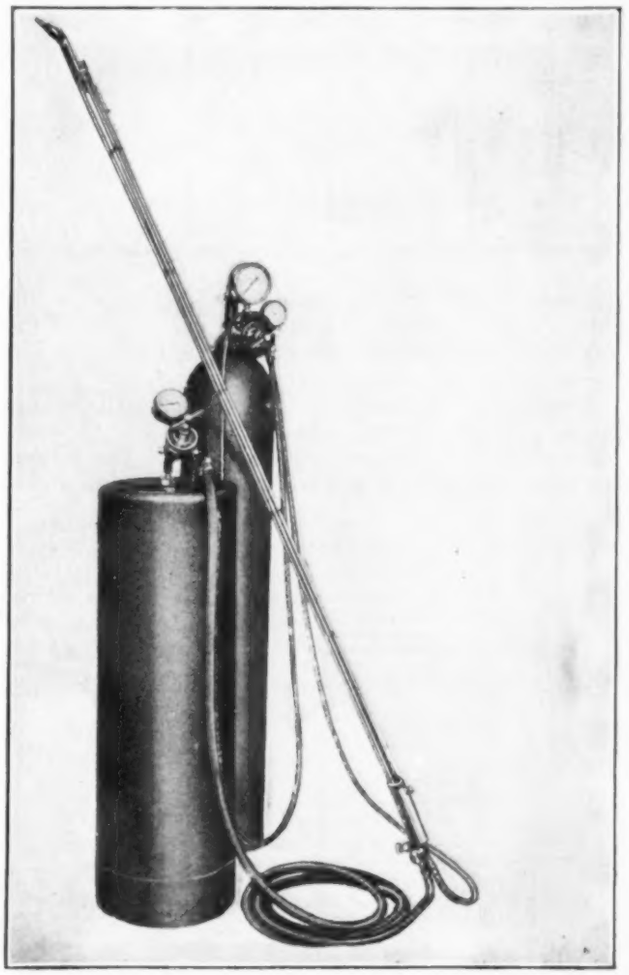


FIG. 136. THE OXWELD STAYBOLT CUTTING-TORCH

torch is shown in Fig. 132. This is their model B. Details are shown in Fig. 133. In this torch, the cutting jet is entirely surrounded by the preheating flame, as the oxy-acetylene is delivered through six openings arranged in a circle around the orifice for the oxygen jet. This arrangement makes it possible for the preheating flame to always precede the cutting jet, no matter in what position the torch is held, or in whatever direction the cut is made, be it horizontal, transverse, circular, elliptical, toward or away from the operator. In so working, the operator does not have to shift his position or turn the torch. This is especially valuable in wrecking steel structures, removing risers

TABLE XVII. OXWELD CUTTING DATA

Thickness of Metal In.	Size of Internal Nozzle	Oxygen Pressure Lb./Sq. In.	Per Hour				Per Linear Foot	
			Speed		Gas Consumption		Gas Consumption	
			Machine Lin. Ft.	Hand Lin. Ft.	Oxygen Cu. Ft.	Acetylene Cu. Ft.	Oxygen Cu. Ft.	Acetylene Cu.Ft.
1/8	No. 1	10	120	90	28	7.8	0.31	0.09
1/4		15	93	74	37	11.3	0.50	0.15
3/8		20	81	62	48	14.2	0.67	0.23
1/2		25	73	55	58	16.3	1.05	0.30
3/4		30	63	46	80	19.7	1.74	0.43
1		35	57	40	100	22.0	2.50	0.55
1 1/4	No. 2	35	53	36	120	23.6	3.33	0.66
1 1/2		40	50	33	141	25.3	4.27	0.77
2		45	46	29	184	27.7	6.34	0.96
3		55	41	24	268	31.9	11.2	1.33
4	No. 3	65	36	20	352	35.6	17.6	1.78
5		75	32	17	436	38.8	25.7	2.28
6		85	29	15	522	41.5	34.8	2.76
8	No. 4	95	23	11	698	46.2	63 4	4.2
10		115	18	8	880	50.3	110.0	6.3
12		135	15	6	1080	53.9	180.0	9.0
14		155	12		1290	57.3		
16		175	10		1520	60.4		
	Rivet Nozzle	40			240	25.0		

from steel castings, or cutting steel scrap, especially where places difficult of access are encountered. The preheating flame is produced in practically the same way as in the welding torch previously shown.

There is a separate valve for controlling the oxygen to the preheater, which enables the operator to secure close adjustment and avoid waste of gas. The oxygen-jet valve is of the plunger type, which is so constructed that its movement produces no tendency to deflect the cutting jet from the line of the cut. The location of the valve lever is on top of the handle and its motion is in the direction of the vertical center plane of the torch. The valve is held open for continuous cutting, when desired, by a simple but effective button-like latch, which may be instantly engaged or released by a slight movement of the thumb. The external nozzle is furnished with a copper tip. The internal nozzle is held in place by tightening the external nozzle. To remove the former it is only necessary to unscrew the external nozzle. This torch is regularly furnished with four interchangeable tips, for cutting up to 1 in.; from 1 to 3 in.; from 3 to 6 in.; and from 6 in. up.

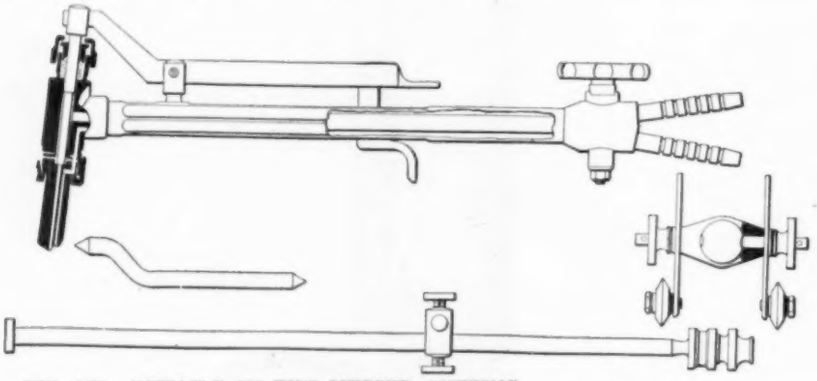


FIG. 137. DETAILS OF THE MESSER CUTTING TOOL

A model-B torch fitted with a specia' rivet-head cutting nozzle is shown in Fig. 134. Another form, known as model C-6, is shown in Fig. 135. This was made to meet the demand for a light, rugged and adaptable cutting torch for work on double bottoms and below decks of ships. In general, it closely resembles the other models. It weighs 2¾ lb. and is 20 in. overall.

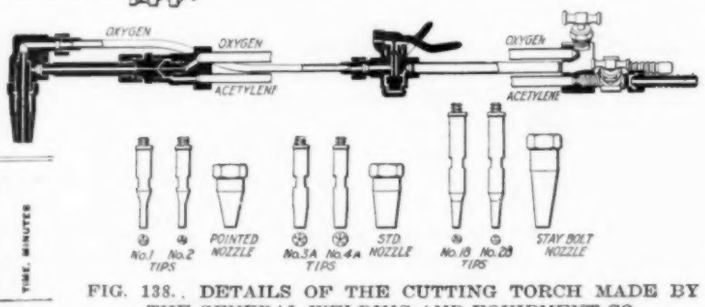


FIG. 138. DETAILS OF THE CUTTING TORCH MADE BY THE GENERAL WELDING AND EQUIPMENT CO.

For cutting inner and outer shells of locomotive fireboxes, where length and slenderness is necessary, the staybolt cutting torch shown in Fig. 136 has been

TABLE XVIII. CUTTING STEEL RISERS WITH THE GENERAL WELDING AND EQUIPMENT CO. TORCHES

TEST NO.	SHAPE OF CUT	NUMBER OF CUTS MADE	TOTAL SQUARE INCHES CUT	TOTAL OXYGEN CONSUMPTION, CU. FT.	SQUARE INCHES CUT PER CU. FT. OXYGEN	SQUARE INCHES CUT PER MINUTE	TIME, MINUTES
1	Different shapes, 1 in. to 5 in. thick	40	615	248	2.84	—	—
2a	Wheel rim 1¼ in.	10	94.5	8	11.8	22.5	4.17
2b	to 2½ in. thick	10	100.6	10.4	9.67	18.3	5.5
3	6½ in. x 8 in.	1	52	14	3.7	27.1	1.92
4	5 in. x 10 in.	1	50	18	2.78	20	1.5
5	5½ in. x 15½ in.	1	85.25	34	2.5	22.8	3.75
6	5½ in. x 15½ in.	1	85.25	28	3.04	26.2	3.25
7	5½ in. x 16½ in.	1	90.75	32	2.84	27.9	3.25
8	11 in. x 11 in.	2	242	112	2.16	—	—
9	6 in. diameter	4	113	46	2.48	11.3	10.00
10	15 " "	1	177	162	1.1	12.6	14.00
11	16 " "	1	200	200	1.0	14.3	14.00
12	18 " "	1	254	250	1.0	15.9	16.00
13	20 " "	1	314	300	1.05	17.3	18.00

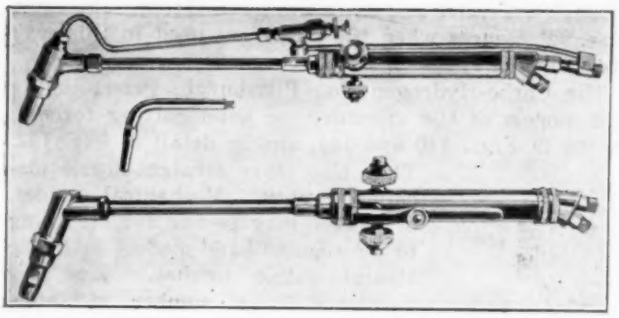


FIG. 139. THE IMPERIAL CUTTING TORCHES

made. This is, however, merely a special form of the model B. The long "stem" is made up of three gas tubes as shown. This torch is regularly furnished in 42, 54, 69 and 84 in. lengths to suit the needs of the user. The 84-in. torch weighs 6¼ lb. The head is set at an angle of 20 deg., which experience has shown is the more generally useful. All the regular nozzles can be used with this torch.

In addition to the torches mentioned, the Oxweld Acetylene Co. makes straight-tipped machine cutting torches, which may be used on any of the cutting ma-

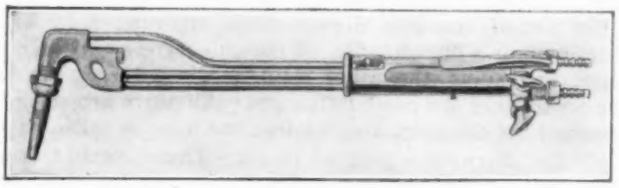


FIG. 140. CARBO-HYDROGEN MODEL C CUTTING TORCH

chines on the market. Like all other cutting torches, small guide wheels may be used for steadying the torch when cutting to straight, irregular or circular lines by hand.

In Table XVII are given the oxygen pressures and amount of gas consumption for various thicknesses of

TABLE XIX. PRESSURES FOR OXY-HYDROGEN CUTTING WITH IMPERIAL TORCHES

Cutting Tip	Thickness of Wrought Iron or Steel to be Cut, In.	Pressures Oxygen, Lb.	Pressures Hydrogen, Lb.
1H	¼ to 2	30 to 40	5 to 10
2H	2 to 4	50 to 70	10 to 15
3H	4 to 6	80 to 100	15 to 20
4H	6 to 9	100 to 125	20 to 25
5H	9 to 12	125 to 150	25 to 30

These figures represent minimum and maximum pressures. For intermediate thicknesses, use pressures in proportion.

metal. The acetylene pressure is the same as for welding, 1 lb. With the data given in this table, and knowing the cost of acetylene and oxygen, the approximate cost of gas for any given job may be calculated with a fair amount of accuracy and serve as a basis for price estimates. It must be kept in mind that old rusty metal, like boiler plate, will take much more gas than will clean metal.

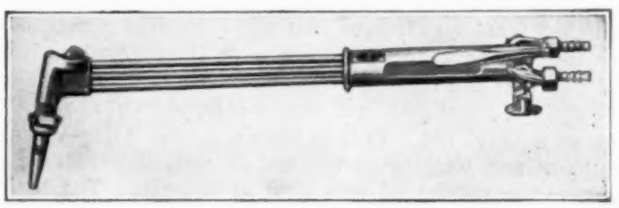


FIG. 141. CARBO-HYDROGEN MODEL B CUTTING TORCH

In order to give the reader an idea of the construction of some of the other well-known cutting torches, a few will be shown. Fig. 137 shows details of a cutting torch made by the Messer Manufacturing Co., Philadelphia. This type of torch will use either medium or low-pressure acetylene, as it works on the injector principle which is independent of the acetylene pressure. The oxygen jet is operated by means of the lever shown on top. The wheel guides are adjustable so that the tip may be kept the proper distance from the work.

The construction of the cutting torch made by the General Welding and Equipment Co., Boston, Mass., is shown in Fig. 138. The valve lever for the cutting

TABLE XX. PRESSURES WHEN USING THREE-WAY GAS SYSTEM

Cutting Tip, No.	Thickness of Steel or Wrought Iron to be Cut, In.	Pressures Oxygen, Lb.	Pressures Acetylene, Lb.	Pressures Hydrogen, Lb.
1T	¼ to 2	30 to 40	5	5 to 10
2T	2 to 4	50 to 70	5	10 to 15
3T	4 to 6	80 to 100	10	15 to 20
4T	6 to 9	100 to 125	10	20 to 25
5T	9 to 12 and over	125 to 150	15	25 to 30

jet has a lock that is easily manipulated with the thumb. This torch will use either medium- or low-pressure acetylene, and like the other torches, will use either acetylene or hydrogen with the oxygen. The parts are easily changed when necessary. The head is fastened to the mixing chamber by means of a ground-joint swivel and loose-nut coupling. The swivel is brazed into the head so as to make a tight joint even under heat. The mixing chamber can be easily taken out and cleaned. The lever key is accessible from all sides and the seat can be replaced in a few minutes.

As has been previously mentioned, the consumption of the various gases for different work can be only approximately estimated beforehand, as so many elements

TABLE XXI. GAS CONSUMPTION AND PRESSURES WHEN USING OXY-CARBO-HYDROGEN CUTTING-TORCHES. THE CARBO-HYDROGEN PRESSURE IS ABOUT 5 LB. IN EACH CASE

Thickness of Steel in Inches	Size of Cutting Tip	Lineal Feet Cut per Hour by Hand	Pressure of Cutting Oxygen in Pounds	Cu. Ft. of Oxygen Used per Lineal Ft. of Cut	Cu. Ft. of Carbo-Hydrogen Used per Lineal Ft. of Cut
¼"	1-A	110	15	1	1
½"	2	90	25	1⅔	1
⅝"	2	75	32	2⅓	1⅓
¾"	2	60	35	3	1½
1"	3	45	45	4⅔	2½
1½"	3	38	50	7	3½
2"	3	28	60	14	6
3"	3-A	18	75	26	9
4"	4	13	85	32	12
5"	4	11	100	40	13
6"	5	8	120	50	13
7"	5-A	7	140	64	14
8"	5-A	6	160	78	16

Above pressures can be increased at times on various grades of steel advantage.

enter into the work. Even in cutting the same piece, if the cut is of any length, the gas consumption and time will often vary to a marked extent from different causes. Parts may be clean and others rusty. The operator's skill will vary as he is fresh or tired, and many other reasons may enter into the calculations. However, tabulations of specific results may often be of considerable value. Those already given have been for average conditions, and are believed to be as near correct as it is possible to get them. The company making the torch last mentioned has made some calculations regarding the time taken to cut clean metal, which will be of interest. On ½-in. steel, the time for cutting 1 ft. with a regular machine cutting tip, was

0.67 min. and by hand, 0.90 min.; for 1-in. steel, 1.25 and 1.50 min. respectively; for 2 in., 1.40 and 1.60 min.; for 4 in., 1.50 and 2.00 min.; for 6 in., 3.00 and 4.00 min. and for 8 in., 3.25 and 4.50 minutes.

An 8-in. steel shaft was cut through in 3 min., using 14 cu.ft. of oxygen; an 18-in. shaft was cut in 16 min. with 250 cu.ft. of oxygen; a 20-in. shaft in

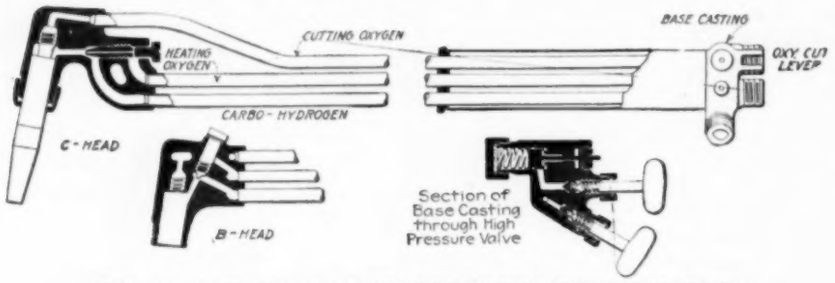


FIG. 142. DETAILS OF CARBO-HYDROGEN CUTTING TORCHES

18 min. and 300 cu.ft. of oxygen. For the last two, oxy-hydrogen was used.

The cutting of steel risers and shafts, under what is claimed to be average conditions, is tabulated as shown in Table XVIII. The tests are classified as follows:

Test No. 1 comprises ordinary work as it came along. Risers were not clean and especially the smaller risers had sand and holes in the core. The oxygen consumption contains all the waste changing from one piece to another.

Test No. 2a was made on clean metal with oxy-acetylene and with a special pointed tip.

Test No. 2b was the same as No. 2a but cut with oxy-hydrogen, a regular tip being used.

Test No. 3 was made on a very clean riser. The operator could rest his hand very comfortably. The cut looked as if it was done by machine.

Tests Nos. 4-7. Cuts were made on risers of a 20-ft. flywheel.

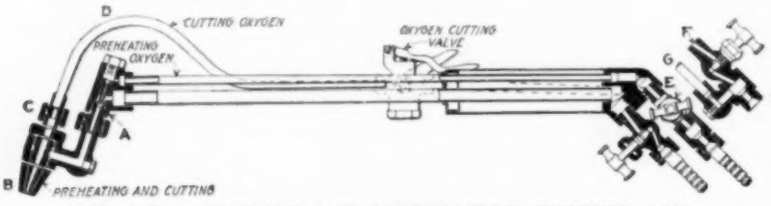


FIG. 143. AIRCO-VULCAN COMBINATION CUTTING AND WELDING TORCH

Cleaning was only superficially done and operator was in a fair, but not ideal position. One riser showed a large blow-hole. The cuts were clean through.

Test No. 8. Two cuts were made on the same flywheel. Risers were well cleaned, but the cranes could not be spared to bring the face of the risers into a horizontal line. They had to be cut diagonally and the operator had to bend so far over that with the first riser he lost his balance and fell and had to interrupt the operation, therefore, no time was taken. The maximum thickness of the cut was 13 in. The cuts were clean through.

Tests No. 9-13. Cuts were made on risers of circular shape. The number of sq.in. cut per cu.ft. of oxygen is in the average lower than with rectangular shapes, as it is too cumbersome to regulate the oxygen pressure according to the varying thickness. It does not pay to start with lower pressure at the beginning and increase it the more the cutter is nearing the center or full thickness of the metal. Moreover, the cuts were made with a two-line cutting torch so that the preheating flames would have suffered with regulating the oxygen pressure in such wide limits. With the heavier cuts of 15 in., 16 in., 18 in. and 20 in. thickness, the principal consideration was to cut through rather than to get stuck, and not look too close to the oxygen consumption.

The Imperial Brass Manufacturing Co., Chicago, makes the cutting torches shown in Fig. 139. These are of the positive-pressure type. *A* is a combination cutting and welding torch, the oxygen pipe and tip being detachable, so that the curve tip may be put on when the torch is wanted for welding. *B* is a cutting torch only. Either may be used for oxy-acetylene or for oxy-hydrogen. When using oxy-hydrogen, the respective pressures are given in Table XIX.

The torches may also be used for the company's three-way gas system, which uses a combination of acetylene, hydrogen and oxygen, as explained under welding torches. The acetylene and hydrogen are mixed through a Y-valve and enter the torch through the same hose. Pressures when the gases are used in this way are shown in Table XX.

The Carbo-Hydrogen Co., Pittsburgh, Penn., makes two models of the injector-type hand cutting torches, shown in Figs. 140 and 141, and in detail in Fig. 142. They also make straight-nozzle machine torches. Mechanical guides, or wheels, may be had for attaching to the regular hand models, or to the straight-nozzle torches. Tips are furnished in a number of interchangeable sizes and shapes. They are made from a solid brass bar, with an outer shell of copper solidly attached with rivets. The preheating holes are arranged closely around the cutting orifice so that the flame cones do not have a tendency to melt edges of the cut. It is claimed that the tips remain cool and do not have to be dipped in water to keep them cool when used for long periods. The regular sizes of the tips are arranged for cutting from the thinnest metals up to 18 in. in thickness, or more with special tips. The head and base castings of the torches are of Tobin bronze and the tubes are of seamless drawn steel, surrounded by an aluminum or a fiber handle. A special swivel-point valve stem, instead of the usual solid needle point, is used for controlling the combustion gas. All parts are easily removed for cleaning, and the injector may be taken out with a pair of pliers. These torches are designed for use with oxy-carbo-hydrogen gas. Carbo-hydrogen is a fixed gas, permanent under all weather conditions. Since it does not solidify there is said to be no residue left in the tanks or cylinders at any time. It is clean, easy to use, and safe, since it is combustible but not explosive within itself. It is a product of the destructive distillation of suitable hydro-carbons, and has a general analysis of 85 per cent. hydrogen and 15 per cent. light hydrocarbons. It is claimed that this gas has no tendency to harden the surface of the metal being cut. It is not a sensitive gas, and backfiring is rare. It is marketed in steel cylinders under 1800 lb. pressure and of about the usual capacity. The pressure is reduced to from 5 to 10 lb. for working purposes, 5 lb. being the pressure usually employed.

In Table XXI are shown the approximate number of feet cut per hour, the pressure of the oxygen and the amounts of the gases used per lineal foot of cut. The carbo-hydrogen pressure is 5 lb. in each case.

Several companies make combination welding and cutting torches. These usually consist of a cutting attachment for the welding torch. As a commercial proposition, such combinations are not to be recommended, but where an operator occasionally has to shift quickly from welding to cutting, they may sometimes be used to advantage. Along with their regular lines of welding- and cutting-torches, the Air Reduction Sales Co., N. Y., put out the combination torch shown in detail in Fig. 143. This is known as the Airco-Vulcan cutting and welding torch, and it well illustrates the general principles of this kind of a torch. The main

body is that of the regular Airco-Vulcan welding torch. The regular welding tip is removed from *A* to receive the connection of the special tip *B*. This tip is connected at *C* to the high-pressure oxygen tube *D*. A combination valve is screwed into the torch body at *E* in place of the single oxygen valve used for welding. This valve has a passage at *F* for the preheating oxygen and one at *G* for the cutting oxygen that goes out through *D*. The preheating flame surrounds the cutting jet as in other regular cutting torches, so that an operator may cut circles or angles without altering the direction of the torch body to any extent.

Meeting the Reconstruction Period With a Depleted Staff

By JAMES LESLIE LANE

WITH hostilities at an end, and himself free to take up the production and marketing of his goods once more, the average manufacturer finds himself in more or less of a quandary. The field looks good, for in many lines the supply during the past two years has been entirely inadequate to meet the demand, and probably the need for speedy and efficient output has never before been as insistent as it is today. Machinery and apparatus of every description have been worked to the point where they are practically worthless and must be replaced at once if the business of the country is not to be impaired.

Despite this he may well wonder how, in the face of the sharp competition he is sure to meet abroad, he is to make headway during the reconstruction period. His tools and equipment are out of date and, for the most part, so badly worn by the tremendous striving for war output as to be practically useless.

The war has for four years put a stop to immigration, and this source of new labor is apt to be more or less uncertain for some time to come, depending a great deal on what stand the different European nations take toward permitting their citizens to seek employment here. The army has taken a goodly number of their mechanics, their clerks, and men from their technical staffs: the younger blood on which they would have depended to carry the brunt of the work. They now find themselves with an organization far below the 1914 standard, since not all will come back and those that do will have lost from two to three years of industrial training. Clearly then, though the war is over, we are not to go back at once to pre-war conditions. Much more than autocracy has been overturned, and business methods of the future demand careful attention as well as the readjustment of European boundary lines.

The matter of sales is not as pressing as that of production, and the first question is how to attain this with the men and tools at hand. The manufacturer should not be content to leave this entirely to his foremen and designers, trusting to them to secure as good and efficient help as possible under the circumstances, unless he is willing to run the risk of being outdistanced by his competitors. Even in normal times it has been clearly recognized that for these two branches to function properly there should be a broad-minded and tactful executive to act as intermediary between them, and it is doubly so today. Both foreman and designer are human and sometimes hesitate before advancing new ideas or making suggestions, each for fear of antagonizing the other. They realize that a certain amount of jealousy and distrust always exists between the designing office and the shop, and there is a tendency to keep their ideas to themselves rather than risk stirring up trouble. This reticence, if the employer is tactful and fair, can in nearly every case be overcome and the business will profit by many new methods and short cuts that would not otherwise become available.

Unfortunately this condition of mutual distrust between office and shop is likely to be more acute than ever at the present time. The average foreman has been used to doing big things during the past two years. Work has been turned out with makeshift machinery and methods hitherto unknown because of the urgent demand for production. The war conditions have developed new practices and the shop man is apt to feel that the office is out of date, and is more than ever inclined to resent any suggestions from that source. On the other hand, the soldier returned to civil life is quick to realize that much new knowledge has passed him by. He hesitates to make suggestions for fear of being ridiculed and is more than ever inclined to play safe and stick to the antiquated methods with which he is familiar. Clearly then, if headway is to be made, it is up to the owner or manager to act as an intermediary in reconciling the opposed elements and bringing forward new ideas.

Even in normal times the manufacturer has probably experienced more or less trouble by reason of costly and ill-considered design. Parts could have been so made that patterns would have been less expensive, intricate machine work avoided, and the work accomplished with tools and machinery at hand. Again specifications would call for special material when standard stock might be utilized to advantage. "If all this trouble arose when times were normal," the owner is likely to ask, "what will happen under the new and changed conditions?"

No hand was ever played less well for knowing what was in it, and it is best at the outset to look matters squarely in the face, to realize that for the present at least the standard of efficiency will not be as high as it has been. If the productive capacity of the shop is not to be lowered, help must be extended where necessary and the deficiency made up.

Instead of leaving the designing office to its own devices the owner will, if far sighted, adopt some plan whereby the designer may profit by the practical knowledge of the shop before plans have left the drawing board.

As soon as a general layout has been prepared in pencil, a half-dozen photostat copies should be made and distributed among the shop departments with a printed form attached explaining that the design is

merely a tentative one, to be looked over for criticism or suggestion before finishing. Each department head who may be called upon later to make some part of the product should receive a copy with instructions to return it with his approval or suggestions noted thereon.

The wording of the form should receive careful attention, for it may determine the success or failure of the venture. Each department head should feel that the request for suggestions is genuine and that the slip is not attached as a matter of formality or shop routine. It should be so tactfully expressed that he will not feel that he is criticizing the designer's finished product but rather making helpful and time-saving suggestions while the design is in its formative stage. If he is put at his ease in this respect and does not feel that he is stepping on any one's toes, the chances are ten to one that he will cut loose as he would not have done had the draftsman asked him personally for his opinion on the matter. The man at the board should be made to understand clearly that the object of this is to help him in his work rather than to criticize his methods.

When the photostats are returned to him he is free to give his whole time and attention to the subject, safe in the knowledge that no one is going to pounce upon him later. In the end this way of handling things will not only avoid costly practices and mistakes but it will lead both shop and technical man to a better appreciation of each other's abilities.

Where possible the method should be extended to the pattern shop and foundry as well. If they are under one management this is, of course, a simple matter but where they are not, suitable arrangements can generally be made with some company receiving the bulk of this work. As each is saved annoyance and delay later, the small amount of time spent in looking over the other's work is negligible when the gain is considered. In most cases the arrangement can be made reciprocal and will not involve any additional cost for either. In cases where this plan is not feasible the trifling cost of engaging a master patternmaker or molder to look over the projected designs at home will prove a good investment when the final cost is considered.

In this way the draftsman will in a short time gather a lot of information that he would not otherwise get if left to go into the shop on his own account where he would feel that he was "butting in."

It is a good plan to have a complete set of data made up, showing the capabilities of every tool in the shop. Let it give in a concise way the capacity of each machine, the size hole it will drill or punch, the over-all dimensions of the work it will take, its speed and the number of square feet of floor space it occupies; also whether it is new or old and how close it will work; whether it is fit for close operations or only adapted to coarse work; the approximate cost of operating it per hour; everything in short that will enable the designer not only to design a part correctly from a mechanical standpoint, but to plan it so that it can be made entirely in the shop with the tools at hand and at a minimum of expense. Thus armed with a clear knowledge of costs and machine capacities the owner will soon find the designer proportioning the parts so that should the occasion require the work can be split up among various tools instead of being handled on only one machine while others stand idle. He will in short find him working with shop conditions in mind, with something more than just the mere detailing and drawing end in view. He will be looking ahead and saving dollars.

Nor should this stop here. The staff should be provided with technical literature on welding, cutting, machinery, etc., and be encouraged to read it. They should be encouraged to keep abreast of the times and gather ideas from outside sources. Above all, they should be encouraged to talk over new ideas with the owner. Some of these ideas may be of little value at first, but however trivial they may appear they should be recognized. Instead of a curt rejection, in case of an impractical idea, the designer should be told exactly why it cannot be adopted, and the next time instead of drawing back into his shell he will come along with something better. A little frank talk and encouragement will do wonders.

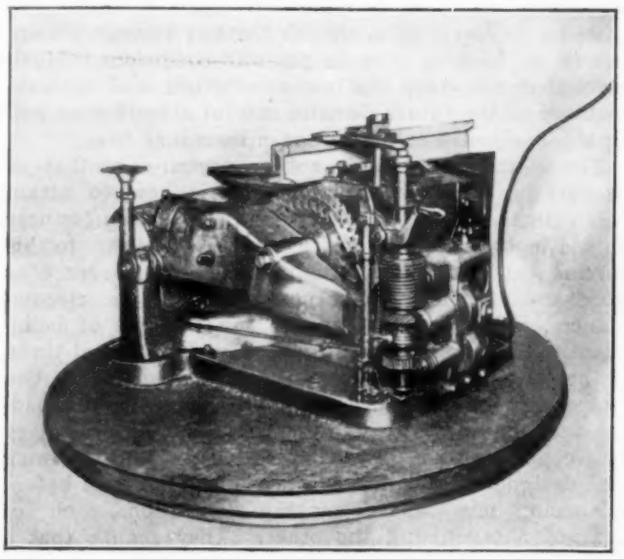
Thus far we have only considered the effect of such a policy on the draftsman. How will it affect the shop man? The management is interested not alone in good design but in the speedy execution of it afterward, and it is a well-known psychological fact that to make a man do his best work you must first make him interested. We are all human and especially interested in seeing the working out of something that incorporates a few of our own ideas, and the very fact that a foreman or machinist has been consulted in advance will secure his coöperation much more effectively than simply handing him a set of the completed drawings and leaving him, without any previous thought on the subject, to devise his own ways and means of doing the work, especially when these plans do not conform to his idea of good practice and are badly suited to the tools he has at hand.

A Cutting-Off Machine Mounted on a Turntable

BY J. J. McINTYRE

A firm in Newark, N. J., having to do considerable work on railroad rails, cutting angles, etc., and being somewhat cramped for room, mounted a Lea-Simplex cutting-off saw on a turntable as shown in the cut. The table can be clamped at any point in the circle.

In making frogs and switches for railroads the rails have to be cut at an angle, hence the advantage of arranging the position of the saw to accommodate the long rails in a machine shop which has very little available floor space.



LEA-SIMPLEX SAW ON A TURNTABLE

US ARMY ORDNANCE NEWS

Manufacturing the 9.2-In. Howitzer Shell—III

By S. A. HAND
Associate Editor *American Machinist*

This article, the last of the series, covers washing, fitting and riveting the base plug, varnishing, baking and the final inspection both by the shop and Government inspectors. It will be noted that the shells do not undergo any heat-treatment, hydraulic or volumetric test and that no adapters, fuse timers, fuse cups, boosters or booster cases are supplied at this plant.

IN FITTING the base plug the shell is held vertically in a floor vise of special construction, as shown in Fig. 28. Details of the vise are shown in Fig. 29. The nose of the shell rests at *A*, which is provided with a copper lining to protect that part from injury. The upper part of the vise is semicircular in shape and is provided with a clamp pivoted at *B* and fastened or released by the swinging screw *C* pivoted at *D*, and the lever-operated nut *E*. Both the stationary jaw and the clamp are lined with leather, which gives a better grip on the shell and prevents the surface from being marred.

The vise is mounted on a concrete foundation and on the front of the base is a semicircular platform of wooden blocks set on end to prevent injury to the shell as it is dropped when released. In Fig. 28 the rope grommet referred to in the previous article may be seen on the shell in the foreground.

FIG. 28. FLOOR VISE

The screw threads of both the shell and the base plug are air-blasted to remove the dirt and oil, and the base plug is turned upside down and the flange tried in the shell counterbore to test the fit. Part of the first thread, which is more or less out of shape due to the machining operations and handling, is cut off with hammer and chisel. Part of the first thread in the shell is also removed, but with a hand scraper shaped like a small hoe. The fitter then paints the shoulder of the shell counterbore with a light coat of liberty (prussian) blue, enters the plug and screws it halfway down. At this point the shop inspector tests the thread fit by grasping the plug with both hands and shaking it. If the fit is passed the plug is screwed home with the wrench *F*, which is provided with two pins *G* fitting into the holes *H*. After screwing the plug home by hand the wrench is struck several blows with a sledge, to firmly seat the plug. The shop inspector then taps the plug all around with a hammer, keeping the fingers of his free hand on the joint. By this means he can tell whether the plug flange is in contact with and rests solidly on the shoulder of the shell counterbore. If it is all right the inspector puts a chisel mark across the joint to mark the home position of the plug when it is finally screwed into place. The plug is now unscrewed half way and the under side of the flange inspected. If it has been properly seated this part will be fully marked with blue from contact with the paint on the shoulder of the shell counterbore.

This fit is very essential, as the shell is not provided with any form of gas check and the close contact between these surfaces is solely relied upon to prevent possibility of flame from the propelling charge reaching the the explosive charge when fired from the gun.

The plug is now removed and with the shell is passed along to be weighed; the two together should weigh not less than 250 lb. nor more than 253 lb. However, if the weight should not be less than 247½ lb. the discrepancy may be made up by fitting an overweight plug, some of which are always kept in stock. As the shells with their plugs are never over weight no provision has been made for correcting an error in that direction. It would seem that weighing before fitting the plug would allow a plug of the proper weight to be selected and fitted in the first place and save the back-tracking and extra work necessary, but the reason given for not doing this is that the proportion of underweight shells is so small that it would not pay to disturb the routine.

ARMY ORDNANCE NEWS

After stamping the plug with the serial number of the shell to which it belongs the two are passed over to the washing department, where the threads of both are thoroughly scrubbed with a hot solution of Oakite to remove all dirt and grease. In addition to cleansing the thread on the shell its whole interior must be cleaned. This is necessary, as the explosive charge has

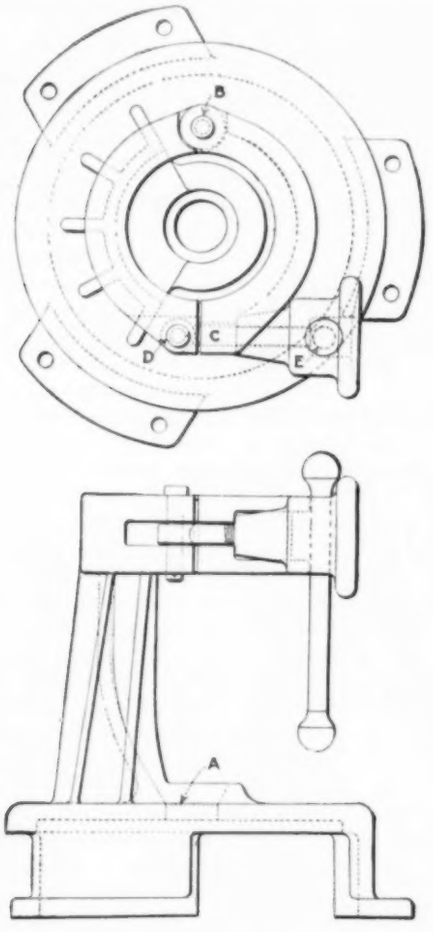


FIG. 29. DETAILS OF FLOOR VISE

a great affinity for oil and grease and would be rendered less stable by their presence.

The shell is rolled onto a cradle mounted on trunnions, which, after receiving the shell, is tipped up into a nearly vertical position as shown in Fig. 30. This brings the open base of the shell into a tank of hot Oakite solution, which is blown into the interior by a steam jet directly beneath the opening. A cap *A* loosely fitted and held in place by gravity covers the nose hole and deflects downward any hot solution escaping at that point, thus washing the exterior. After cleansing, the cradle is dropped back to a horizontal position and the shell is rolled onto an adjoining and similar cradle where the former operation is repeated except that water is used instead of cleansing solution.

As all operations on the interior of the shell are finally inspected by gages before the base plug is put in to stay, it is necessary that it should be cooled after the hot washing and rinsing. For this purpose it is

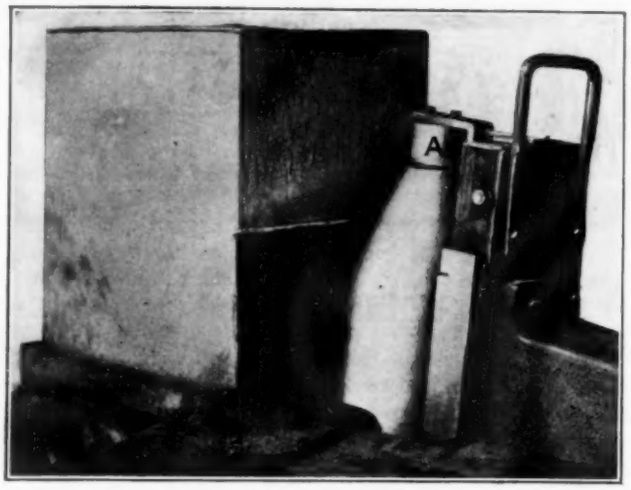
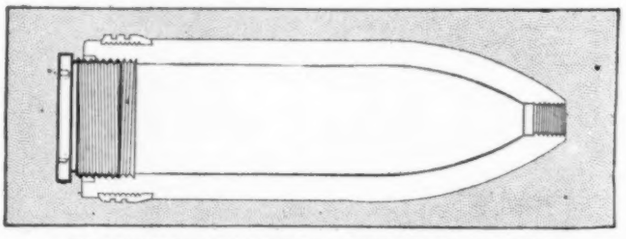


FIG. 30. CRADLE FOR WASHING SHELLS

put under a cold-water spray coming from a series of pipes parallel with the shell length and arranged around half the diameter.

After cooling and gaging, the shell is put in a floor vise similar to the one used for fitting the base plug. The base plug is now screwed home, which position is indicated by the chisel mark on its flange coming fair with that on the shell base.



TRANSFORMATION FOR OPERATION 514—FIT BASE PLUG

Machine—Special floor vise. Number of operators—One. Cutting tools—Chisel and scraper. Production—Thirty per man in eight hours.

To prevent the possibility of moisture reaching the explosive charge this joint must be sealed. This is a riveting or calking operation and is done before removing the shell from the floor vise.

An air hammer provided with a ball-ended tool is used for this purpose in connection with a shouldered

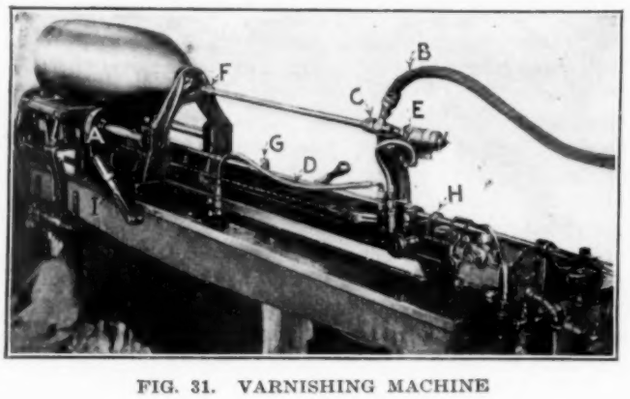


FIG. 31. VARNISHING MACHINE

ARMY ORDNANCE NEWS

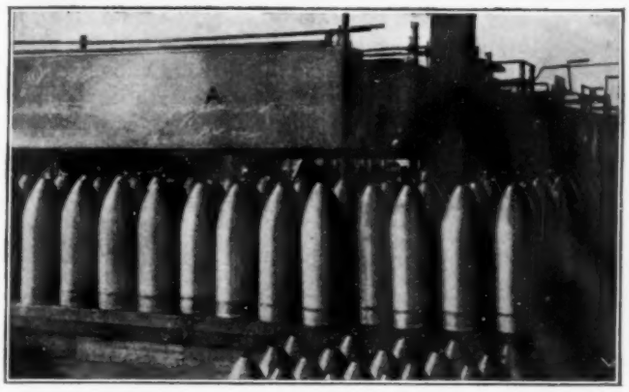


FIG. 32. ELECTRIC OVENS FOR BAKING THE VARNISH

ring that is put over the shell base and used as a guide for the calking tool. The hole in this guide ring is enough larger in diameter than the joint to allow the center of the calking tool to come directly over the joint when pressed against the interior wall of the ring. By

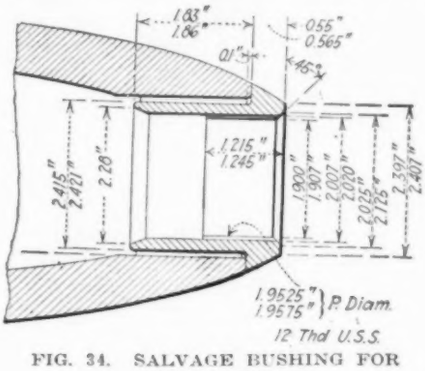


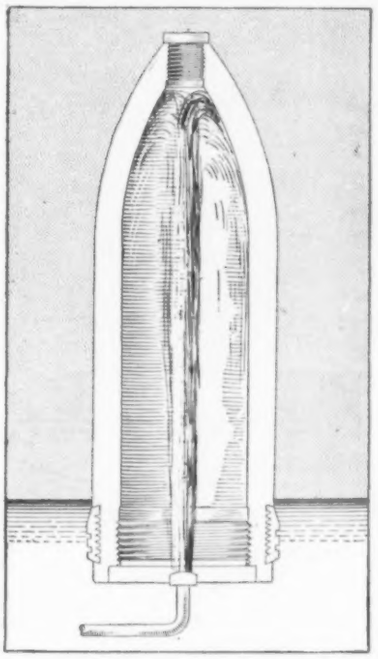
FIG. 34. SALVAGE BUSHING FOR SHELL NOSE

keeping the tool in this position and moving it around the interior of the ring the joint is thoroughly calked.

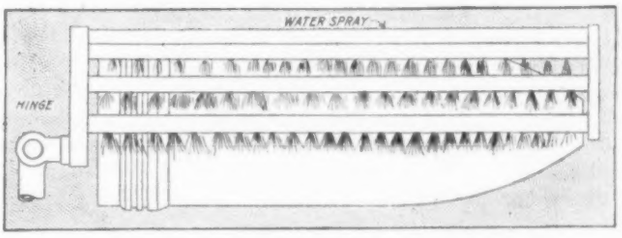
This operation is now subjected to Government inspection, and when passed the shell is stamped for size and class and also with the manufacturers name or initials. After final inspection by the shop it is varnished on the inside in a machine, Fig. 31, built especially for that purpose. The shell rests on four rollers, one of which may be seen at *A*, and is slowly revolved thereon by friction, power being supplied from a motor.

Varnish is conducted from an elevated tank through the flexible tube *B* to the ejector *C*, which is supplied with compressed air by the flexible tubes *D* and *E*. By the action of the ejector the varnish is emitted in the form of a spray through suitable perforations in the nozzle *F*.

In operation the nozzle *F* is passed into the rear of the shell through the hole in the nose, and the carriage, on which the spraying apparatus is mounted, striking the tappet *G*, opens the air and varnish valves, setting the spray in operation. When the spray is withdrawn



FIRST OPERATION



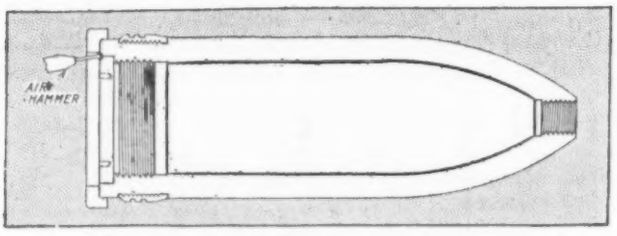
SECOND OPERATION

TRANSFORMATION FOR OPERATION 516—WASH

Machine—Special. Number of operators—One on machine and two on bench. Work-holding device—Cradle. Production—Four hundred and seventy-five per man in eight hours.

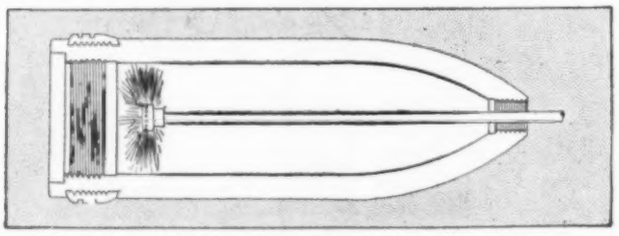
FIG. 33. THE BOND ROOM (GOVERNMENT INSPECTION)

ARMY ORDNANCE NEWS



TRANSFORMATION FOR OPERATION 518—RIVET BASE PLUG

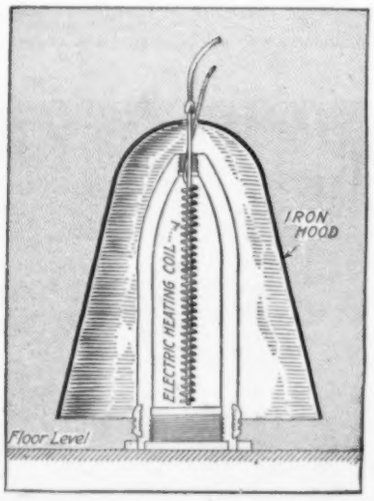
Machine—Air hammer. Number of operators—One. Work-holding device—Floor vise. Tool—Ball-pin riveting tool and air hammer. Special fixture—Ring fitting over base of shell to guide calking tool. Production—Four hundred and seventy-five per man in eight hours.



TRANSFORMATION FOR OPERATION 520—VARNISH INSIDE

Machine—De Vilbiss varnishing machine. Number of operators—One. Work-holding device—Rollers. Production—Four hundred and seventy-five per machine in eight hours.

the carriage strikes the tappet *H* just before the nozzle leaves the shell and closes both the air and varnish valves. It will thus be seen that the shell while slowly revolving is thoroughly coated with varnish on the inside and that the automatic closing of the valves prevents the wasting of varnish and the bespattering of objects. Upon removal of the spray a long-handled brush is inserted in the still revolving shell and moved back and forth once or twice to thoroughly spread and even the coat of varnish. Depressing the level *I* raises the shell from the rollers, and it is then rolled down a slight incline to the electric ovens shown in Fig. 32, of



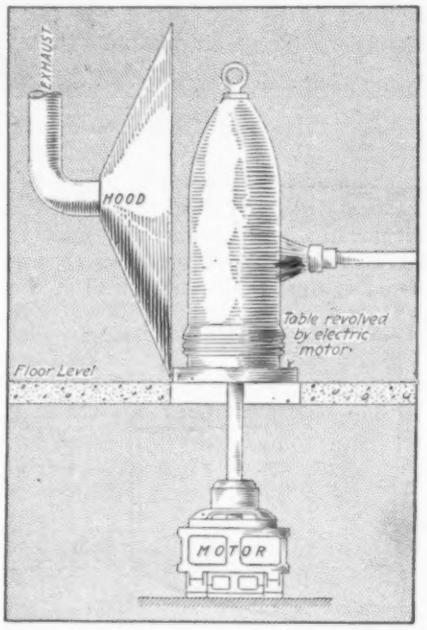
TRANSFORMATION FOR OPERATION 521—BAKE

Machine—Special electric bake oven. Electric-heating coil inside shell; one oven accommodates nine shells; 27 ovens in battery; bake for three hours. Production—Five hundred in eight hours.

which there are 27, each one taking care of nine shells that are stood on end in shallow locating cups.

Electric-heating coils inside the metal hoods *A*, and therefore invisible in the illustration, are lowered into the shells and the current turned on. The hoods cover the shells while being baked and prevent dissemination of the heat. Three hours are required to thoroughly dry the varnish.

After varnishing, the shells are ready for the final



TRANSFORMATION FOR OPERATION 524—VARNISH OUTSIDE

De Vilbiss hand spray—Revolving table at floor levels. Shellac varnish mixed with blue or lampblack. Production—One machine easily takes care of output.

Government inspection, which is done in a separate room known as the bond room. This inspection includes examination of the interior by an electric lamp to see that it has been thoroughly covered with varnish and that too much varnish has not been applied, check weighing, gaging all operations on the outside and a hammer

FIG. 35. A SMALL PERCENTAGE OF SHELL FORGINGS IN STOCK

ARMY ORDNANCE NEWS

test of both the base plug and the copper band to detect any looseness.

Several girls are engaged on this inspection, and when at work they stand in long pits so that as the shells are rolled along the floor they are at convenient height for inspection. After passing inspection a cast-iron plug with an eye in it is screwed into the nose. This acts as a stopper to keep out dirt and the eye can be used for hoisting.

The final operation is varnishing the shell on the outside and stenciling it for size and class. In varnishing, the shell is stood on end on a revolving table at the floor level, power being furnished by a motor below the floor. Lampblack or a blue pigment mixed with shellac is sprayed on the revolving shell by an air-operated spray moved by hand. Behind the revolving table is a large cone to catch any varnish that may miss the shell or be splashed from it. The cone

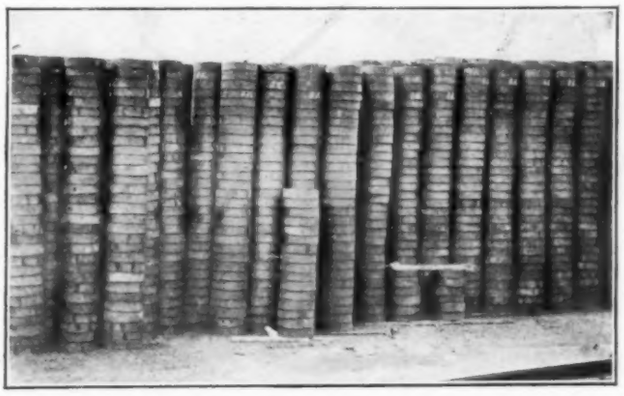


FIG. 37. ONE OF MANY PILES OF COPPER BANDS

is connected to an exhaust system which carries off the varnish fumes. The varnish dries almost immediately and the shell is then stenciled in yellow with its distinguishing marks.

This final operation has brought the shells close to a door outside of which a freight car stands ready to receive them. Its floor and that of the bond room (Fig. 33) are on the same level so that loading is a comparatively easy matter.

Two salvaging operations are allowed on shells that fail of inspection. First, if a copper band is loose or any work upon it has been improperly done the shell may be rebanded, in which case all operations that are done after the original banding must necessarily be repeated; second, if the nose of a shell is bored or tapped too large or if the hole in the nose should be in bad condition either before or after tapping it may be rebored and a bushing screwed in as in Fig. 34. In this case all operations on finishing the nose must be repeated and the end of the bushing finished to the proper profile.

FIG. 36. BASE-PLUG FORGINGS

To show the abundance of material kept ahead, three views in the yard are appended. Fig. 35 shows a small percentage of the shell forgings on hand; Fig. 36 shows some piles of base-plug forgings, and Fig. 37 shows one of the many piles of copper bands in the rough.

PERSONALS

Col. William P. Barba, who was appointed Major in August, 1917, and who has been on duty in the office of the Chief of Ordnance, has been discharged. Before entering the service, Colonel Barba had been with the Midvale Steel Co. for 37 years. His permanent address is 3107 Coulter St., Germantown, Philadelphia, Penn.

* * *

Lieut.-Col. Charles E. Warren of the Liberty National Bank, 60 East 42nd St., New York, who was transferred from the Q. M. C. as Major, in May, 1917, has returned to civil life. He is a graduate of the University of California.

* * *

Lieut.-Col. Eugene T. Savage, who was appointed Major in January, 1918, was discharged on his return from France recently. While with the A. E. F. he acted as Division Ordnance Officer. He attended Yale University and before entering the service was with T. R. Savage Co., Bangor, Me., where he lives. Colonel Savage will resume his former business.

* * *

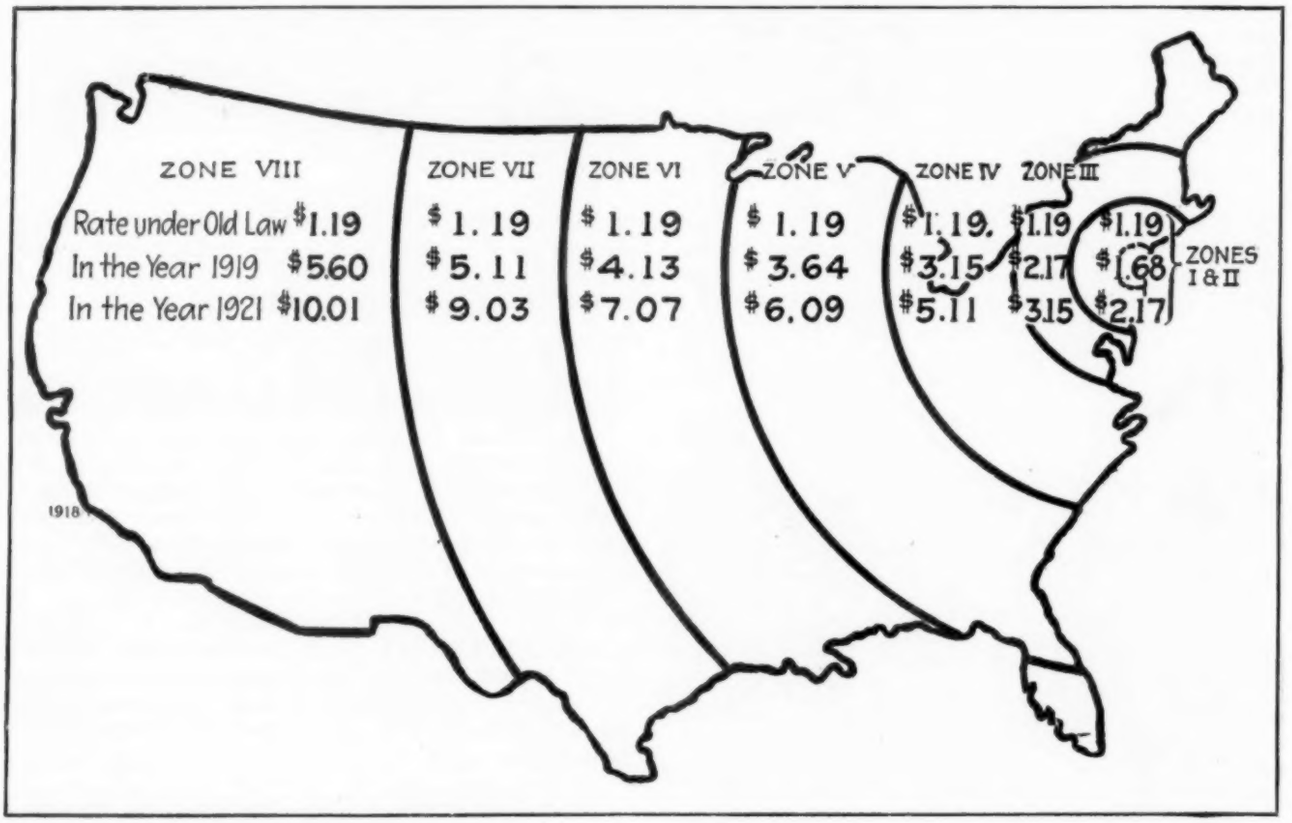
Lieut.-Col. L. H. Van Dusen, who was appointed Captain in June, 1917, has been discharged. He has been in charge of the Civilian Personnel Section. He is a graduate of Princeton University and University of Pennsylvania Law School. Previous to entering the service Colonel Van Dusen was a lawyer with the civil service commission, Philadelphia, Penn. His permanent address is 1012 Stephen Girard Bldg., Philadelphia.

* * *

Maj. George E. Carpenter, of Montpelier, Vt., has returned to civil life. Major Carpenter came into the Ordnance Department from the National Guard in November, 1917, and has served as Divisional Ordnance Officer with the 81st Division, A. E. F. He was formerly treasurer of Norwich University.

Where Do You Live?

This map shows the zones created by the Postal Zone Law and the postage to be paid on your copy of the *American Machinist*.



NOTE—For the year 1918 we paid the penalty postage. For the year 1919 we are billing our subscribers who live west of the Mississippi $1 extra to cover a part of the Zone Postage. There will be another increase in 1920 and still another in 1921. (See Map.) If the Zone Law is not repealed, we shall be compelled to readjust our subscription price so that the Subscriber will pay according to the Zone in which he lives.

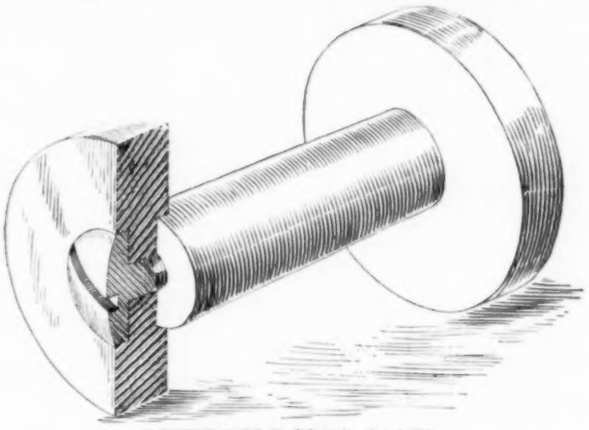
Prior to this Zone Law all citizens had equal rights.
Why should not these rights be restored?

Ask your Congressman!

Renewable Plug Gages

By I. B. Rich

In order to decrease the cost of upkeep of plug gages, particularly those of such diameters as 1½ in. and over, the H. H. Franklin Co., Syracuse, N. Y., is making plug gages with removable heads as shown in the illustration. As the front end of the gage always



REVERSIBLE PLUG GAGES

wears first, it is an easy matter to reverse the gaging heads, these being designed especially for this purpose.

Each side of the gaging head is countersunk to fit the end of the handle, and the head of the screw which holds the handle in place is made of the same size so that they are easily reversible. Then when the front or entering end of the gage wears a trifle small, the head is simply reversed and the gage made usable for another period.

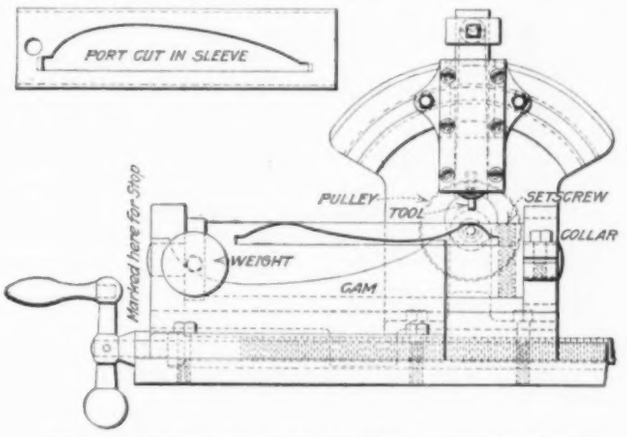
A Machine for Slotting Recoil Cylinders

By Charles Runzi

The accompanying cut shows a machine for cutting the peculiar-shaped slot in the recoil-cylinder sleeve shown in the upper left-hand corner. This port opening was held to a very close margin and as each sleeve was completed, the inspector would try his gage which had to fit the aperture. Two tools were used on this job; one, $\frac{3}{16}$ in. round by 1¼ in. long, and the other, a flat tool ¼ x ⅜ by 1¼ in. long. The round tool was used to cut the curved part of the port and the flat one to cut the straight part.

The following is the method of operation: The tube or sleeve is put in a jig so as to drill an oil hole a certain distance from the end as shown in the cut, the same jig being used to drill another hole in the sleeve from which the tool commenced its cut. To place a sleeve on the arbor, the collar must be removed. When the sleeve is in place with the oil hole over the headless screw in the arbor, this screw is partly backed out. As this screw is somewhat larger than the oil hole and has a slight taper, it will lock the sleeve in position. The collar is then replaced and clamped in position by the capscrew as shown, and the carriage is moved to the left.

The cut is started at the hole which was put there for that purpose. The weight fastened to the arbor



RECOIL-CYLINDER SLEEVE AND MACHINE FOR SLOTTING IT

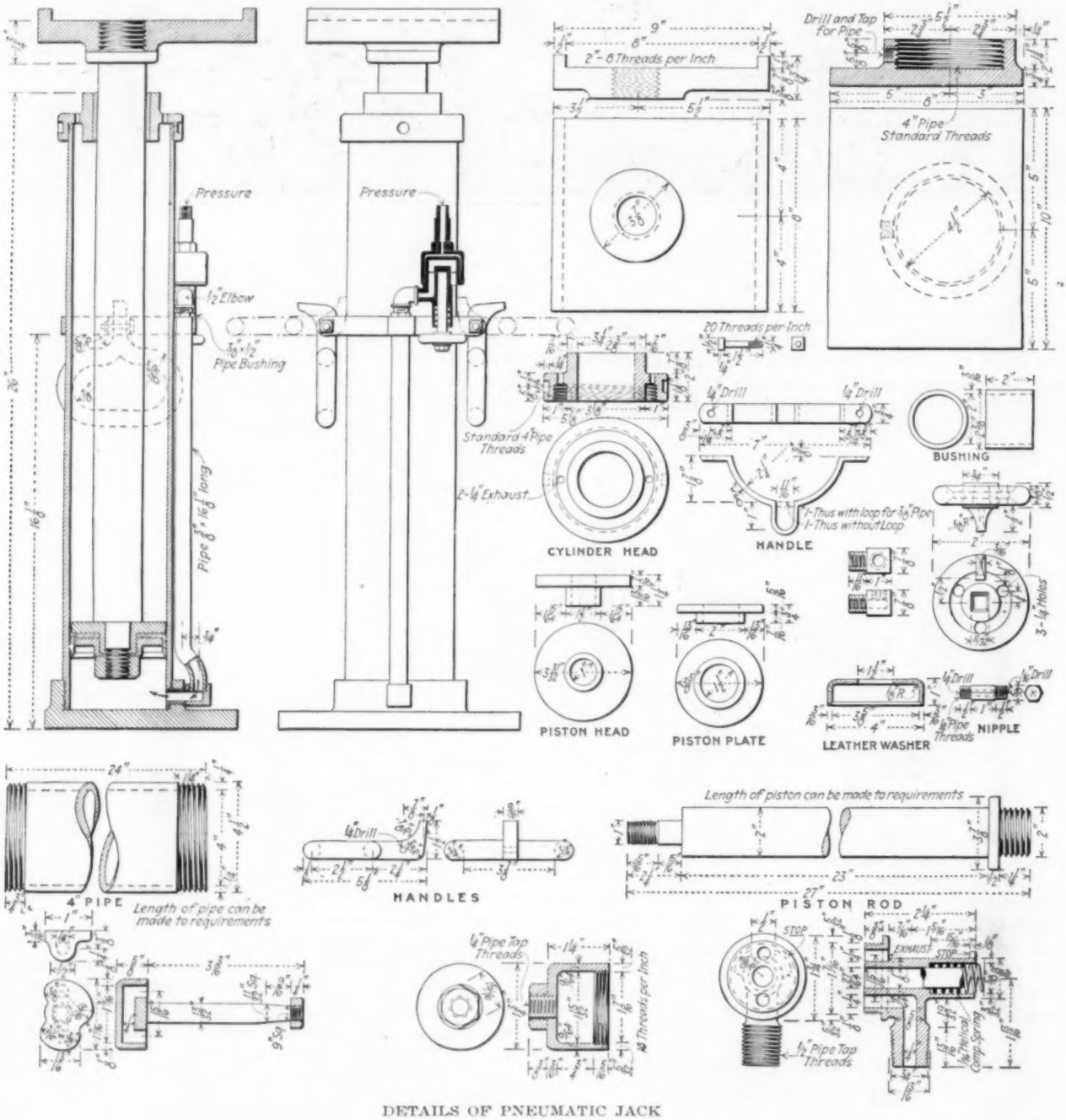
will cause the latter to follow the curve of the cam which determines the outline of the curved side of the slot. When the weight reaches its highest position, it is locked by tightening the capscrew. The round tool is replaced by the flat one and the straight part of the port is cut on the return movement of the table. The head which carries the ram may be thrown over at an angle to undercut the face of the port at the points indicated. As soon as a few of the sleeves were done, the machine was marked as shown in the drawing and the operator could then go ahead and turn out the parts almost as fast as he could turn the handle.

Pneumatic Jack for Locomotive Work

By J. Long

The pneumatic jack shown in detail in the drawing has been found to render valuable service in locomotive repairs. Its principal use is for putting in place the heavy pedestal caps which, owing to their weight and the difficulty of getting them into the position they occupy,

ordinarily require the services of two or three men to place them. These jacks are used in the pit, and to place a pedestal cap it is only necessary to put the cap on the top shoe of the jack, turn on the air and guide the cap to place. The cylinders are made of 4-in. extra-



DETAILS OF PNEUMATIC JACK

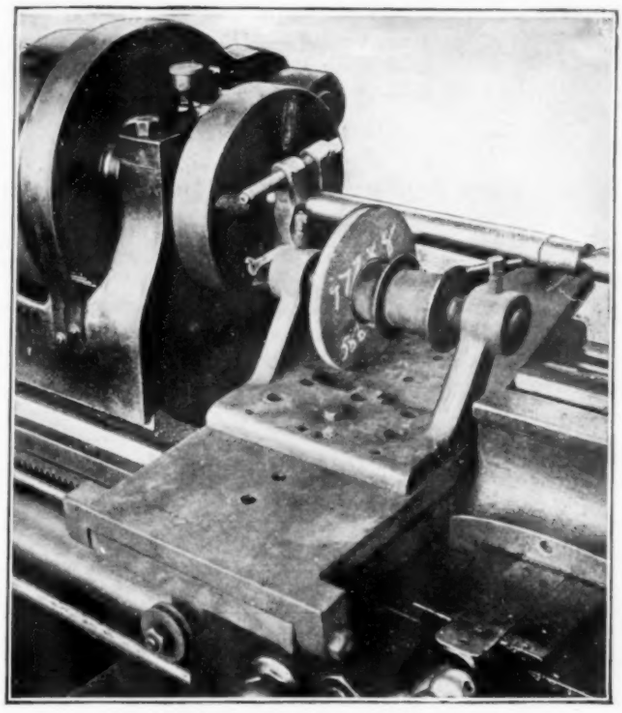
heavy wrought-iron pipe bored, and the piston is of axle steel and is fitted with a leather cup washer. The details are very clearly shown in the drawing.

A Patriarch Among Grinding Machines

BY JOHN DREW

The grinding attachment shown in the cut is not primarily a thing of beauty, and it may not remain a joy forever, but its claim to distinction is its long and useful existence. It is indeed the grandfather of grinding machinery, having been in service even before the universal grinding machine became a commercial factor. No one seems to know how old it is nor by whom it was built, but in the shop where it has its present domicile it is known to have been in use 35 years ago, and was to all appearances as old then as it is now.

It is not now in service but is posed for its portrait upon a comparatively youthful and vigorous lathe of the vintage of about 1880. The attachment bolts onto the wings of the lathe carriage, is provided with its own crossfeed and vertical adjustment, and the wheel bracket may be set in any desired position on the rise and fall plate. There is no provision, however, for grinding tapers except by the more or less good old method of shoving over the tailstock.



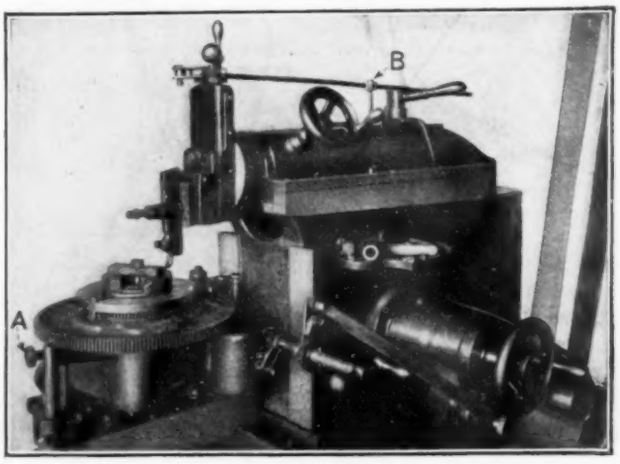
AN ANTIQUE GRINDING ATTACHMENT

The wheel arbor ran on conical points in wooden bearings contained in iron poppets that were adjustable endwise in their brackets. The wheel shown on the spindle is a present-day product, but otherwise the device presents exactly the same appearance as 50 years ago. Should occasion arise, it could be put into service again upon short notice and within its limits would no doubt set a good pace for even the most modern of grinding machines.

Shaping Machine Rigged to Cut Special Cams

BY A. DES ANGELIS

The illustration shows how a shaping machine was arranged to cut a quantity of two-, three- and four-step face cams. The rotary fixture was made to fasten on the knee of the machine and the feed is through the medium of bevel and spur gearing by the regular pawl and ratchet feed movement, which has been transferred from its normal position on the crossfeed screw to the feed shaft of the fixture. A new and longer connecting-rod was required.



NOVEL CAM-CUTTING RIG

The knob *A* operates a clutch, which disengages the power feed and allows the rotary table to be turned quickly by hand to any desired position. The starting positions for the various cams are indicated by lines upon the rotary table, and a stationary finger which enables the operator to accomplish the indexing quickly and accurately.

A pawl and ratchet feed is also supplied to the vertical slide in the head of the machine and is operated by a rod which slides freely through a ring in the stationary stud *B*, the movement of the rod being stopped at the required point at either end of the stroke by collars fastened to the rod by setscrews.

The forgings come to this operation bored and faced so that only the rise and the lower dwell are left to be machined. The "operatress" clamps a forging in place, turns the table to the line which indicates the starting point of that particular cam, drops in the clutch, starts the vertical feed by engaging the pawl and goes to the next machine.

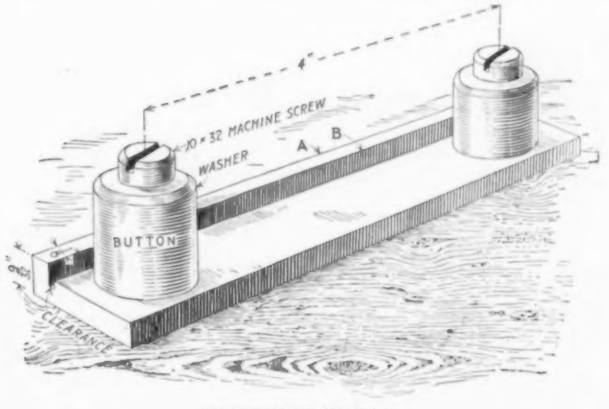
When the bottom of the rise is reached the downfeed is disengaged and the lower dwell is finished by the rotative movement alone. As the tool reaches the vertical face of the next step it is necessary to stop the machine, raise the tool and reset the table for the next cut.

An Easily Made Sine Bar

BY J. B. GRAY

The article by John Teckeer on page 260 of the *American Machinist* deals with a subject and a tool upon which, it seems to me, much more might well be said. In studying Mr. Teckeer's sketch and text, however, it seems to me that in making such a sine bar one would experience considerable difficulty in attaining the high degree of accuracy required in a tool of this sort.

The sketch shows how I made my sine bar. It is very accurate, the center line of the buttons being parallel with the working surface *A* within 0.0001 in. Moreover, the bar is easily made during working hours,



SIMPLE SINE BAR

as most of the work can be carried along simultaneously with the company work. I would suggest that no attempt be made to make the buttons, for it will probably be more convenient and satisfactory to buy them.

The bar is made of machinery steel and should be

roughed out approximately to size and shape before pack-hardening. The tap holes can be drilled in a minute or two and tapped during lunch hour, and at the same time the clearance groove for the grinding wheel can be cut with a hacksaw. The surface *B* for aligning the buttons and the working surface *A* must be ground at one setting. For this purpose a saucer wheel is used, reversing its position for each surface. For this operation the sine bar should be clamped on a low paralled block. In the bar described, both buttons are free to move. They are set for distance with a pair of either outside or inside micrometers and kept against the aligning surface when tightening.

Figuring Diameter of Three-Surface Tangent Plug

BY CLEVELAND C. SOPER

In connection with the design of a flush-pin gage for a gun part the problem of obtaining the diameter of a plug tangent to three surfaces arose. A solution for

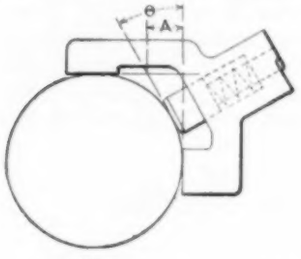


FIG. 1

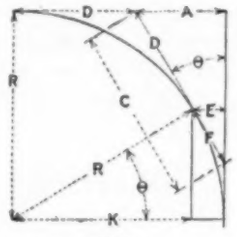


FIG. 2

FIGS. 1 AND 2. SMALL FLUSH-PIN GAGE

Fig. 1—Gage with three surfaces tangent to plug. Fig. 2—Double-scale diagram

a general case is submitted with the hope that it may be of assistance in similar cases.

Fig. 1 is a sketch of the plug and gage for testing the relation and angularity of the small pin with regard

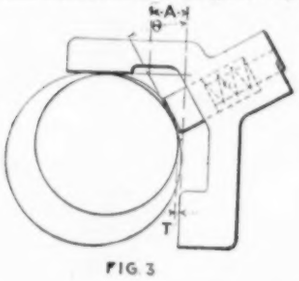


FIG. 3

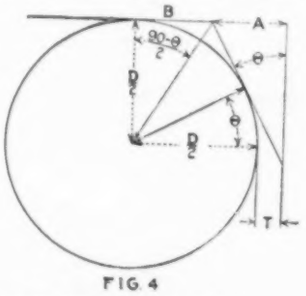


FIG. 4

FIGS. 3 AND 4. LARGE FLUSH-PIN GAGE

Fig. 1—Gage with two surfaces tangent and size block. Fig. 2—Double-scale diagram

to the perpendicular surfaces of the frame. It is desired to find the diameter of a plug which will properly locate the flush pin to permit grinding the flush end. The angle θ is given and also the intercept *A*. This solution applies only when the surfaces are long enough to be tangent to the plug. Another solution is given for the case where they are not.

In the diagram, Fig. 2,

$$C = \frac{A}{\sin \theta}$$

$$D = R - A$$

$$F = C - D = \frac{A}{\sin \theta} - (R - A)$$

$$E = F \sin \theta = A - (R \sin \theta) + (A \sin \theta)$$

$$K = R - E = R \cos \theta$$

$$R \cos \theta = R - A + R \sin \theta - A \sin \theta$$

$$\therefore R = \frac{A\,(1 + \sin \theta)}{1 + \sin \theta - \cos \theta}$$

The required diameter of the plug is of course equal to

$$2R = \frac{2\,A\,(1 + \sin \theta)}{1 + \sin \theta - \cos \theta}$$

Fig. 3 illustrates the case where the plug is not tangent to all three surfaces and a size block has to be inserted. The smaller circle represents a standard plug of convenient size which is tangent to two of the surfaces and to the size block *T*.

In the diagram, Fig. 4,

D = Diameter of the standard plug

$$T = A + B - \frac{D}{2}$$

$$B = \frac{D}{2} \tan \left(\frac{90 - \theta}{2} \right)$$

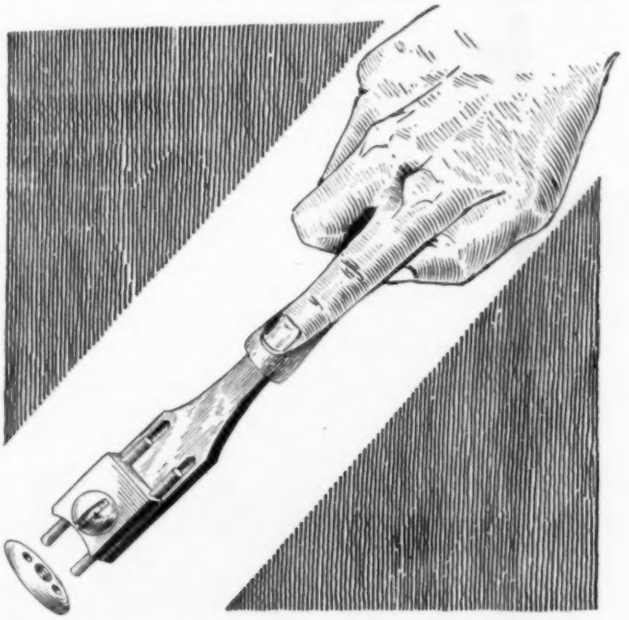
$$T = A + \frac{D}{2}\left[\frac{\sin (90 - \theta)}{1 + \cos (90 - \theta)} \right]$$

$$= A + \frac{D}{2}\left[\frac{\cos \theta}{1 + \sin \theta} - 1 \right]$$

A Spanner With Renewable Pins

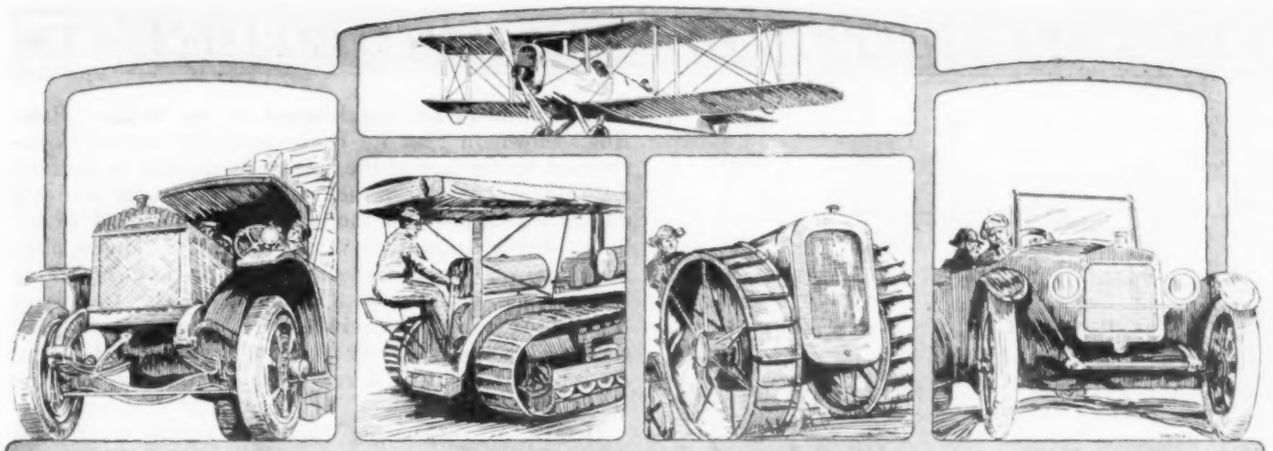
BY R. G. KENYON

Our assembly department was putting together parts requiring the peculiar-shaped little nuts shown in the sketch to the number of 5000 or more per day. The



IMPROVED SPANNER SCREW DRIVER

screwdrivers or spanners in use were first made solid and every time one of the projections broke off there was a job for a toolmaker to repair it. We soon devised the tool shown in the sketch in which the projections are of drill rod which is cut in suitable lengths and tempered all over. Now when a point breaks off, we loosen the binding screw, push out the drill rod and grind the broken end smooth.



AUTOMOTIVE CONSTRUCTION

Modern Methods of Making Motor Cylinders

BY FRED H. COLVIN
Principal Associate Editor, *American Machinist*

It often happens that shops with a comparatively small output devise and use methods which would do credit to a much larger plant. The question of production costs is not always as carefully considered with relation to the output as in this case. The cylinder department of the Locomobile Co. has reduced handling to a minimum.

IN STUDYING the methods used by the Locomobile Co., Bridgeport, Conn., in the production of the Riker truck, it must be borne in mind that, as with the building of the Locomobile passenger automobile, it is not a case of quantity production but of a somewhat limited output. In spite, however, of this being almost a custom-built product in most cases, the question of cost has been carefully considered and both machines and fixtures are employed to insure duplicate production and to bring the cost within a reasonable figure.

In order to show what is accomplished in this direction, the operation sheet for the cylinders is given, as well as the production per hour. Remembering that the cylinders are cast in pairs, it can easily be remembered that the number of castings handled per hour is one-half that of the cylinder production shown in the operation sheet. The cylinder job is concentrated in one small building to reduce handling. The first operation is performed on a No. 6 Becker vertical milling machine as shown in Fig. 1. The cylinder casting rests in a special fixture having four jaws, *A*, *B*, *C* and *D*, and two stop screws, one of which is shown at *E*. The jaws are controlled by right- and left-hand screws operated by a

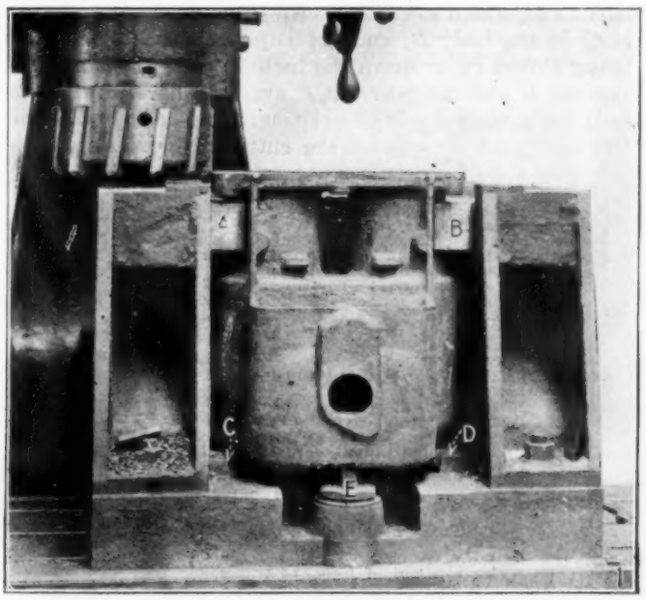


FIG. 1. MILLING THE CYLINDER BASE

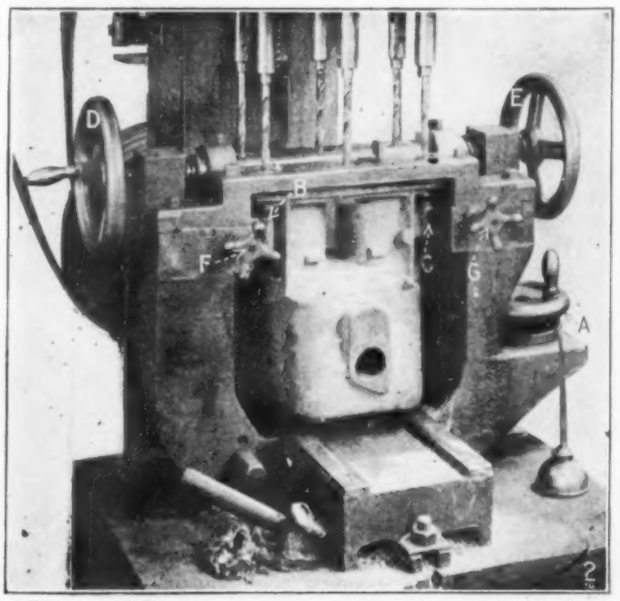


FIG. 2. DRILLING HOLES IN THE BASE FLANGE

AUTOMOTIVE CONSTRUCTION

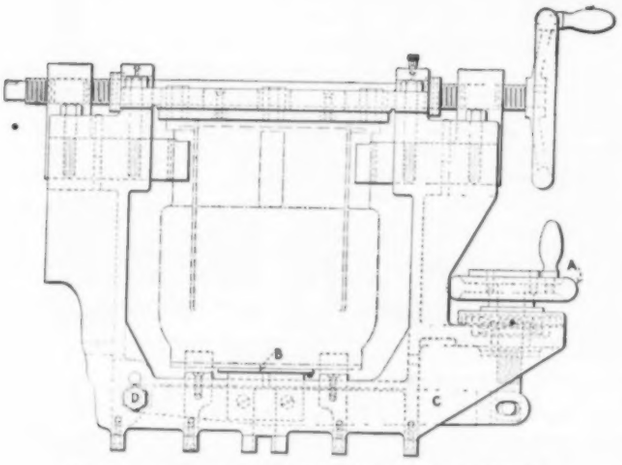


FIG. 3. DETAILS OF THE DRILLING FIXTURE

socket wrench at either end. This is really a chuck which centers and holds the cylinder block while being milled. As the future operations are positioned from this face, it is important that it be properly located and held during this operation.

Next comes the drilling of the bolt holes in the base flange, as shown in Fig. 2. This utilizes a similar fixture, although its construction is somewhat different and the lower pair of jaws is omitted. The cylinder base is first forced up against the under side of the top of the fixture by means of a wheel at *A*. The casting is then centered and held by the jaws *B* and *C* operated by the handwheels *D* and *E*, and locked in position by the setscrews *F* and *G*. Fig. 3 shows details of the upper plate and side clamping fixtures. The operation of the lower holding clamp is made clear when it is seen that the wheel *A* operates a screw which lifts the plate *B* by means of the lever *C*, the latter being pivoted at *D*. This holds the cylinder firmly in place during the drilling operation.

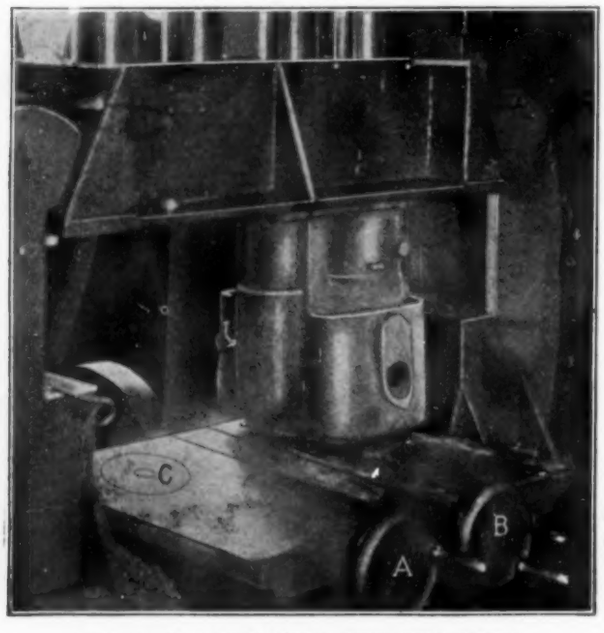


FIG. 4. ROUGH-BORING THE CYLINDERS

The cylinders are rough-bored on the Moline "Hole-Hog" shown in Fig. 4. Here again the casting is positioned by the face of the bottom flange, but in this and all future operations, the bolt holes fit over suitable dowels which position the cylinder with regard to the bore. The cylinders are raised against the upper plate by means of the handwheels *A* and *B*, these operating lifting pads, one of which is shown in *C*. Details of this fixture are shown in Fig. 5, which shows how these pads are elevated by means of a wormwheel operating as a nut. This is a very simple but efficient fixture for this purpose.

Details of the boring head are shown in Fig. 6. This has six blades which are adjustable on the 8-deg. angle shown. This boring head consists primarily of the central bar *A* which carries the boring head *B*, the latter being prevented from turning by means of the key shown The body *B* is held in place by the circular nut *C*, which is operated by a double-pin wrench. The

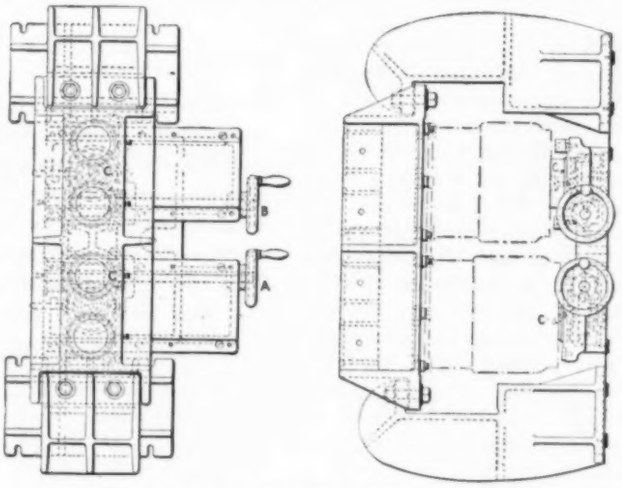


FIG. 5. DETAILS OF THE BORING FIXTURE

cutters *D*, which are also shown in detail, fit in suitable slots in the body *B*, and are adjusted for diameter by being moved up or down the incline. The front adjusting nut *E* and the rear nut *F* are both beveled so as to hold the cutters firmly in position. The end view shows the rake on the tooth of the cutting edge. Adjusting

OPERATION SHEET

No. 1. Snag and clean, 8 per hour.
No. 2. Sandblast, 14 per hour.
No. 3. Mill base, 8 per hour.
No. 4. Drill 6 holes in base flange, 36 per hour.
No. 5. Drill rough cover stud holes, 40 per hour.
No. 6. Bore cylinders, 12 per hour.
No. 7. Counterbore top of stud-hole bosses, 36 per hour.
No. 8. Mill top and side connections and spot cylinder, 10 per hour.
No. 9. Ream for grinding, 10 per hour.
No. 10. Recess top end of bore, 38 per hour.
No. 11. Drill holes for connections on 12-spindle drill, 24 per hour.
No. 12. Ream and tap valve cap holes, 6 per hour.
No. 13. Drill and ream valve-stem guide holes, 14 per hour.
No. 14. Counterbore valve-stem guide holes, chamfer bore, drill and tap pipe plug holes, 12 per hour.
No. 15. Countersink and face counterbore valve seats, 10 per hour.
No. 16. Tap connection holes and valve-spring cover, 30 per hour.
No. 17. Mill top of center bosses on base flange, 60 per hour.
No. 18. Grind cylinder bore, 2 per hour.
No. 19. Grind valve chamber, 18 per hour.
No. 20. Clean top end of bore, 12 per hour.
No. 21. File and chip, 3 per hour.
No. 22. File finish, 20 per hour.
No. 23. Retap valve cap holes, 20 per hour.
No. 24. Wash in soda and oil.

AUTOMOTIVE CONSTRUCTION

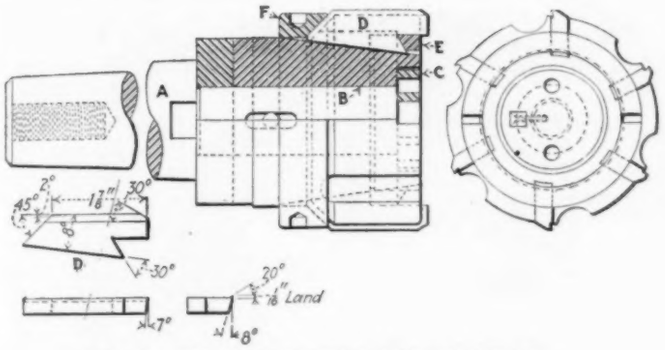
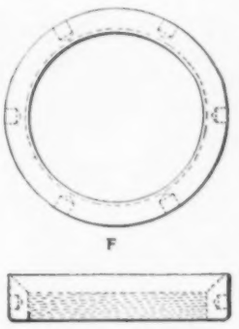


FIG. 6. DETAILS OF THE BORING HEAD



the two nuts *E* and *F* varies the diameter as may be necessary.

After being bored, the cylinder blocks are placed in the fixture shown in Fig. 7 and water pressure applied to the jackets. This fixture allows the cylinder to be swung in any desired position, there being an index and latch on the end of the trunnion.

A Large Double Milling Machine

The next operation is the milling of the tops and sides of the cylinder, this being done on a special double Beaman & Smith milling machine. This has two heads and also has four tables. Fig. 8 shows the front of the machine with two of the tables in place. An extra table is shown at *A*, where it can be loaded with the cylinder while the machine is running. Each table holds three blocks or six cylinders, which are positioned by means of the bolt holes already referred to and held firmly in position by the simple but substantial clamps shown. These form a part of the holding fixture *B*, the same thing being shown on the table which is in position on the milling machine.

As soon as the cuts have been taken, the table with the finished cylinders is lifted off by means of the sling shown, and brought back to the position of the empty table by means of an overhead trolley on which the air hoist used for lifting is fastened.

Fig. 9 shows the gage used for setting the milling cutters in the proper position for work on the cylinder. This needs practically no description, it being fastened in position on the face of the milling fixture and the cutters adjusted to it. This same gage is also used for setting the milling cutters on the second head, which is shown in Fig. 10. This is a close view between the heads of the machine, showing the large cutter on the top which finishes the upper surface and the two small cutters which mill the cylinder sides for the covers

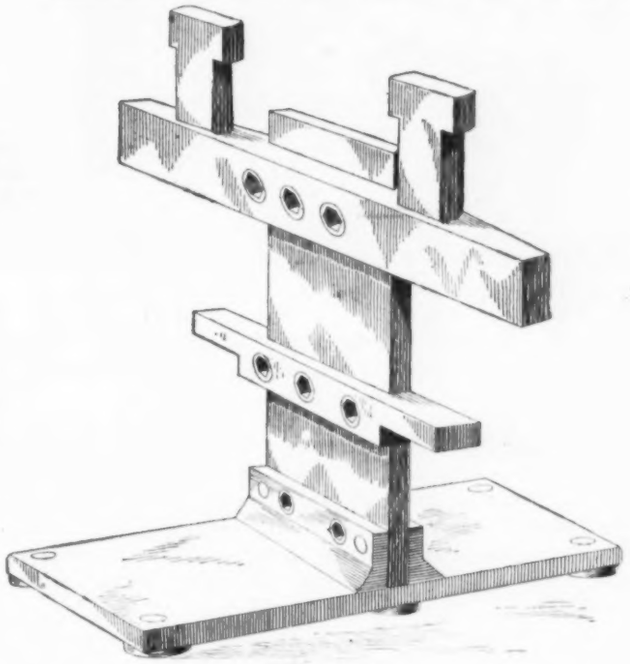


FIG. 9. GAGE FOR SETTING MILLING CUTTERS

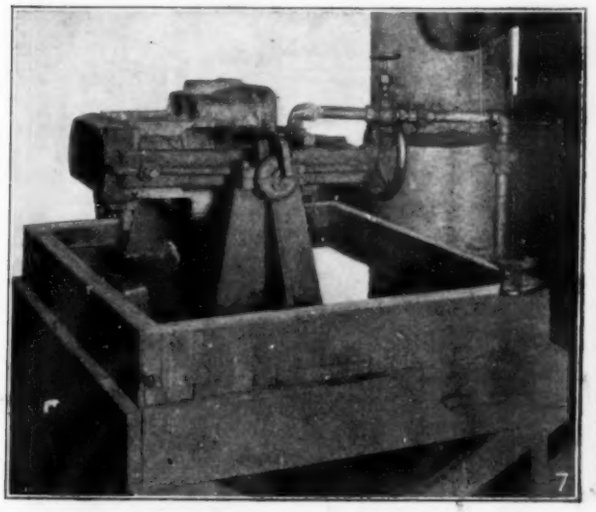


FIG. 7. TESTING WATER JACKETS

FIG. 8. MILLING THE TOP AND SIDES OF THE CYLINDER

AUTOMOTIVE CONSTRUCTION

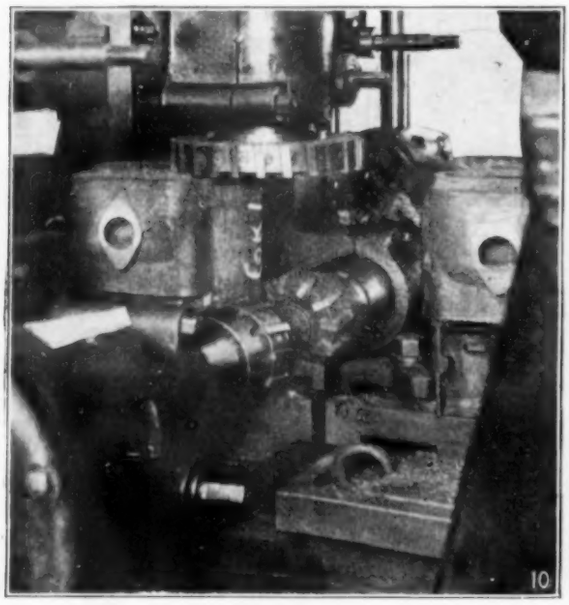


FIG. 10. VIEW OF THE SECOND MILLING HEAD

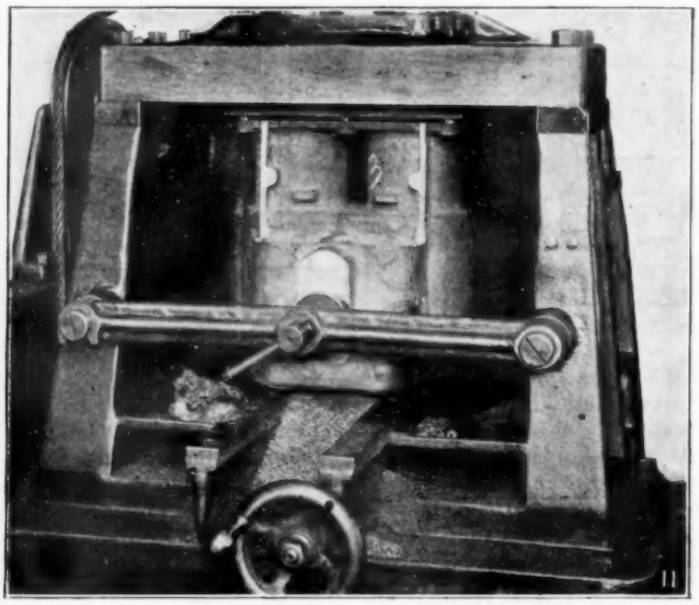


FIG. 11. REAMING THE CYLINDERS

inclosing the valve guides and push rods. This illustration also shows the type of clamp used in holding the cylinder.

The cylinders are reamed in the fixture shown in Fig. 11, this being a Foote-Burt machine. Here again the cylinders are located by dowels in the base, held up against the upper surface by a pad operated by the hand-wheel shown and clamped in position sideways by means of the cross-bar and screw shown. This leaves the bore ready for the final finish on the Heald grinding machine.

THE RECESSING TOOL

After reaming, the cylinder bore is recessed by the bar shown in Fig. 12. This consists of the body *A* carrying the plunger *B*, which has about an inch movement inside the bar. The latter carries the recessing cutter *C*, which is moved outward by means of the angular slot *D* in the end of the bar *B*. Collars *EE* are guides in the cylinder bore. The collar *F* rests against the flange end of the cylinder, the ball-thrust bearing *G*, held in position by locknuts *H*, determining the depth to which the bar can enter the cylinder. The collar *I* carries a pin through the upper end of the bar *B*, preventing it from turning but at the same time allowing end movement. With the bar in the cylinder, an end movement of the plunger *B* throws the recessing cutter *C* out into the cylinder bore and makes the necessary recess. The clamp *J* fits the outside of the spindle and aids the taper shank in driving.

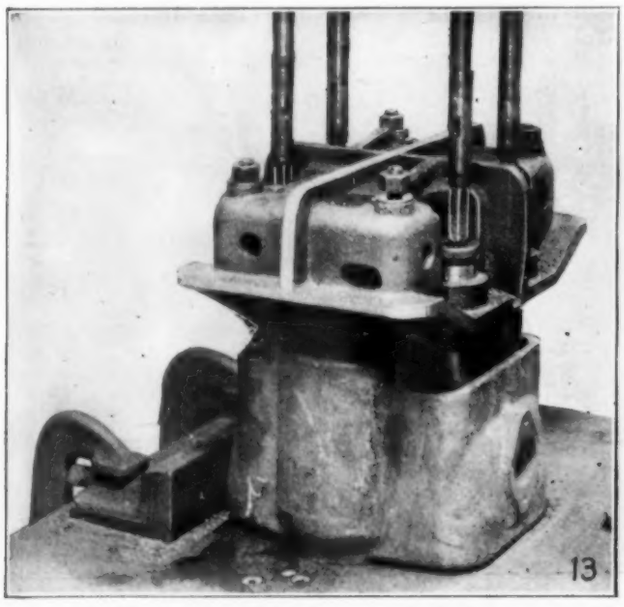


FIG. 13. REAMING THE VALVE-STEM GUIDES

FIG. 14. INSPECTING FINISHED CYLINDERS

AUTOMOTIVE CONSTRUCTION

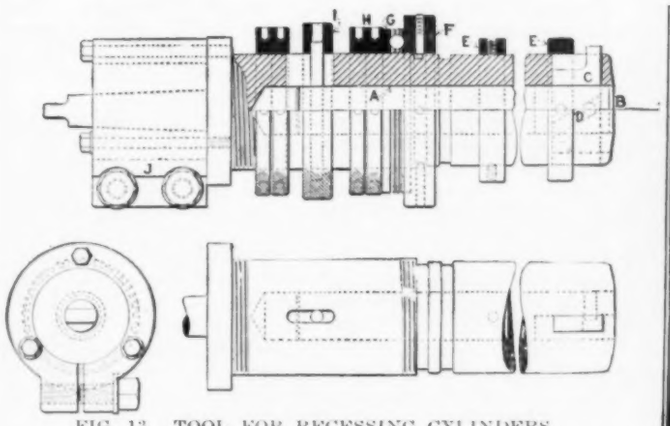


FIG. 12. TOOL FOR RECESSING CYLINDERS

Next comes the reaming of the valve-stem guide, using the box jig shown in Fig. 13, this being also located from the bottom of the cylinder flange. It will also be noted that an angle plate is clamped to the table of the drilling machine to assist in locating the casting in proper position between the four spindles.

Fig. 14 shows the final inspection of the cylinder to determine if the bore is at right angles with the flange. The inspection jig shown fits inside the bore, and the swinging arm, which is provided with a micrometer head, easily indicates the relations between the bore and the face of the flange. Fig. 15 is a corner of the inspection room where the pistons are gaged before being sent to stock to be issued to the assembling department.

FIG. 15. FINAL PISTON INSPECTION

Convention of Employment Managers

IF ANYONE had previously doubted the growth of the vocation of Employment Manager, the attendance at the third annual Convention of the National Employment Managers' Association at Cleveland, Ohio, May 21 to 23, should dispel all question on the subject. An attendance of approximately 1500 men and women, nearly all of whom were members, representing many cities and a great variety of industries, compels the realization that the problem of securing and keeping an adequate working force is of much greater magnitude than we had hitherto realized. It is a problem which affects all industry in much the same way, even though the method of treatment may vary in some of its details. The establishing of a human, personal relationship; of building up confidence and coöperation in all things pertaining to the work and the worker has become necessary in all varieties of industry.

According to Dudley Kennedy, who is well known from his work of employment direction at the Hog Island shipyard, the first organized work along this line was probably done by B. F. Goodrich about 20 years ago, but it is only very recently that we have realized the need of restoring, so far as present conditions will permit, the personal relations between employee and employer that existed in the days of the small shop. We must realize that the workers are intelligent, if not always educated; that they cannot be fooled by pretended interest, or form or mummery of any kind; that back of all demands, even those which may be unreasonable or foolish, is the desire for self expression in matters which concern them; that they resent being known only by a check number instead of a name.

We must put interest and joy back into the work; we must consider the well-being of the worker, which is very different from the welfare work which has been done in the past. Mr. Kennedy also pointed out that the general public had a direct interest in the proper and efficient conduct of every business because they, as customers, paid all wages, profits and costs of production.

The question of the forms to be used in conducting employment offices was the occasion for considerable discussion, and general opinion deplored the tendency to increase the number of these forms, one case where 86 were used being cited as a horrible example.

George D. Halsey of the Cincinnati Milling Machine Co. advocated one card large enough for all records, so that all data pertaining to a man might be available at a glance in all cases where such reference was necessary. This card is letter size, 8½ x 11 in., and allows for a very complete record which covers all data for the visiting nurse and other service work which may be necessary.

Mr. Halsey warned against the danger of letting any method or system cause us to forget the human element and pointed out the necessity of trying to make every man feel that nothing has been left undone to give him a square deal; of showing why certain things cannot be done. He has found it helpful to check up decisions as to judgment of men to see how correctly we have picked them. Interviews should record impressions as a help in determining how well the employment manager's judgment is borne out in practice. Foremen should grade the men in their shop at least once in every three months.

Rodney Morrison, Jr., of the American International Shipbuilding Corporation, emphasized the fact that we must realize that forms and methods were but tools with which to perform certain necessary functions. What really counts is to know how to use them to best advantage. He advocated close coöperation with the foremen, familiarizing them with the whole policy of the organization, getting their complete coöperation in the whole plan of securing the best men for the various departments. Nor must we lose sight of the fact that the acid test of any plan or system or theory is, in the long run, that of economies. Does it pay? Not in cold cash or dividends alone but in net returns to the stockholders, the management, the workers and the community.

The employment men are dividing themselves into two

groups on the question of their relations with the foremen and other executives. One group believes that the employment office should select and hire the men and turn them over to the foremen much as the purchasing agent buys the material which they draw from the stock room. The others feel that, while they can perhaps secure men to better advantage than the department foreman, the final decision should rest with the man whose department record depends not only on the new employee as a mechanic but also on his adaptability to the particular environment and his ability to coöperate with others in the department. They feel that the case in no way compares with the purchase of material and cannot be argued from the same standpoint.

If, as all agree, the foreman must represent the firm to the workers, he must be treated with consideration and not be made to feel that he is a mere cog in the machine and that his judgment of men is of no consequence. While the autocratic foreman is a relic of the past we must not make a puppet of the present one and still expect him to correctly represent the firm to the men.

Earl Morgan emphasized the need of man-consciousness on the part of all and of suiting the men to the foreman, who should have the final selection. Unfortunately most foremen are not specially trained or fitted for their work but just "happen," from seniority or otherwise. There is necessity for the more careful selection of foremen with regard to their ability to understand and get on with men as well as to their mechanical ability. In fact some very successful managers consider the faculty of handling men of more importance to a foreman than is his mechanical training.

Mr. Morgan advocated the following up of men after they go into the shop to see how they progress, to check up mistakes of judgment in selection and to show the men that all interest in them is not lost the minute they have passed into the shop. In order to get satisfactory workers the employment office must know what qualifications are required. It is not enough to specify a $25-a-week lathe hand, but the qualities needed and not the price should be the guide if economical production is to be obtained.

The Returned Soldiers

Major Church, who is in charge of the section of the country east of the Ohio line, told of the work of getting the returned soldier back into industry, the work of his branch being to assist the organizations already in existence to do their work. When we realize that there are 55 such organizations in New York City alone, the need for coördination becomes apparent and the establishment of a clearing house becomes a necessity.

About 80 per cent. of the returned soldiers go back to their old jobs and there are few cases where they have been refused employment. About a third of the remaining 20 per cent. do not go back to their old locality but try to get work in the East. Major Church urged that the business men look upon the returned soldier as a good investment. The fighting blood in business is a good thing. He also urged that the country get busy in putting things back where they belong. Repairs and additions have been too long neglected. Let them be made now and provide openings for all who seek employment, particularly the returned soldier.

The possibilities of the motion picture in industry were brought out by Leslie W. Sprague of the Community Motion Picture Bureau. He showed how workers can be interested in their work, the psychological effect and the mental refreshment of well selected pictures. Either at noontime or in a ten-minute recess, the effect of a good film has proved to be beneficial.

One of the Ford industrial films was shown, that of making shoes in a modern factory. The titles given not only told the story but also the reason for high prices and how these could be lowered. When it is considered that we receive over 80 per cent. of our impressions through the eye, and that the motion picture presents the greatest opportunity for having the right kind of impressions given, their possibilities become apparent. He believed there was no question as to their being used as an aid to better understanding with the workers, but that nothing could take the place of good working and living conditions. Americanization, conciliation and coöperation all find the motion picture a useful medium.

Mr. Handy, vice president of the Bray Studios, showed some interesting examples of their work illustrating the mechanism and functioning of intricate machinery. These are invaluable in educational classes of all kinds and played no small part in instructing raw recruits both in the manual of arms and in the handling of the various kinds of arms and munitions.

The convention was strenuous in its schedule and some subjects naturally overlapped. L. P. Alford spoke on the "Employer, Employee, and the Public," tracing the relations from the days of the one-man shop to that of the absentee owner. He pointed out the need of considering the relation of any business to the community as well as to its stockholders. He suggested a reward for an employee's service to his fellows as well as to his employer, and quoted H. L. Gantt as saying that the use of "task and bonus" may give way to straight day work or piece work once more. Mr. Alford regretted that the Community Labor Boards had not had time to become really active before the armistice became effective and suggested that some sort of a substitute might be found desirable.

W. A. Grieves, assistant secretary to Jeffrey Mfg. Co., whose work in this line is well known, gave the results of their experience, which goes to show that the average man is both fair and honest; that confidence and the square deal are absolutely necessary; that morale cannot be bought, but must come as the result of right thinking, right action and right environment. He pointed out that we were not living in the same world as before the Kaiser lifted the lid; that the stage setting had changed. But he also urged against being stampeded, as the foundation was fairly solid and the new ideas can be assimilated.

He pointed out that the reactionary and the radical were equally dangerous but that the average worker thinks straight and can be depended upon. He warned against attempting to develop any committee system too rapidly, as only long experience in economic justice, mutual confidence and fair play will bring about real industrial democracy.

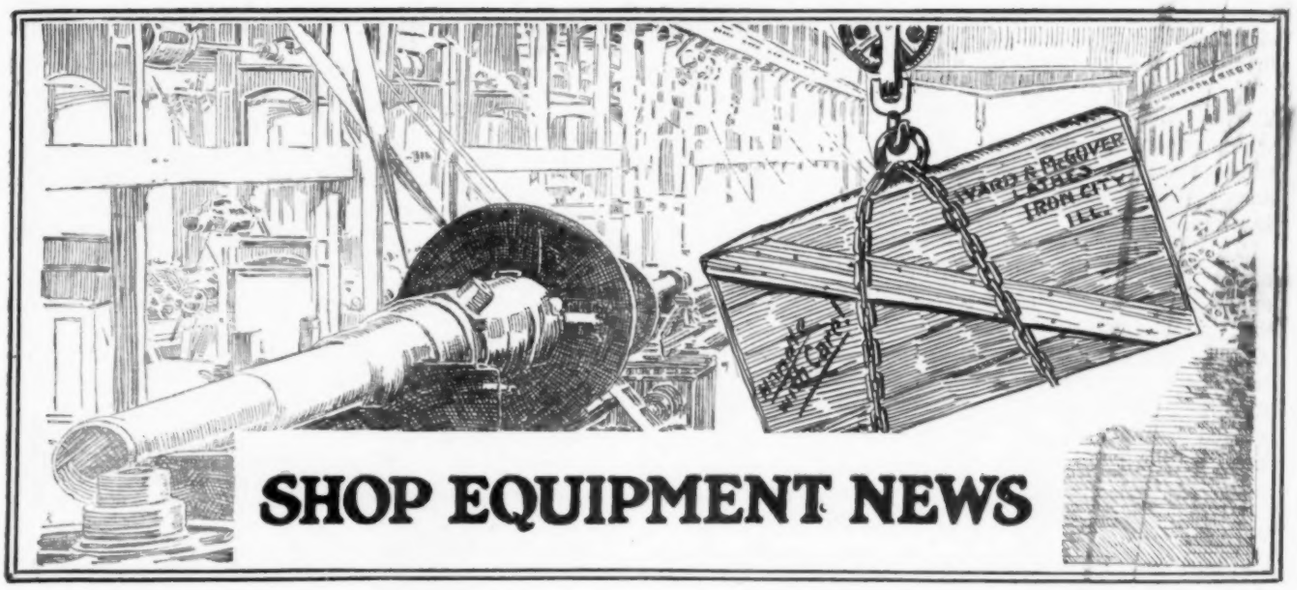
Other papers included the Measurement of trade skill; Training and placing disabled industrial workers; Safety as the employment executive should see it; Stabilizing the working force; Breaking in new workers; Profit-sharing; Insurance and bonus; Organizing the working force and the human relations department from the standpoint of the industrial physician.

At the banquet which followed, Cyrus McCormick, Jr., Works Manager of the International Harvester Company, spoke of the good results they had obtained from employee representation, of the benefits of labor's desire for a voice in industry and the recognition of the right to exercise self-determination.

He compared the older way with Frederick the Great of Prussia, a benevolent despot, who did what he believed was best for the people but did not consult them or give them any voice in its doing. He believed the men had a moral right to full representation from each department and that an easy channel of appeal should be provided whenever decisions seemed unfair.

This, and all other questions, should be settled on the basis of, "is it right?" and "does it pay?" A good system brings to the manager's attention abuses or bad practices, of which he has no knowledge and enables him to make speedy correction. No move of this kind should be taken hurriedly. Have joint conferences before you adopt a new measure as well as afterward, and go into it whole-heartedly. Unless it is sincere and truly democratic it will not succeed. Mr. McCormick told of one demand for wages which could not be met, but instead of making trouble it probably brought employer and employee closer together, for the men were shown the books of the company, shown the costs which would make a wage increase impossible, and the demand was readily withdrawn.

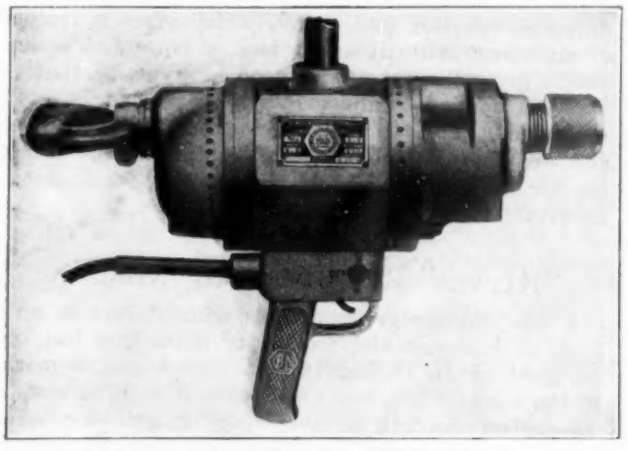
The whole tone of the convention was both hopeful and helpful, and the concerns represented were of such magnitude as to indicate a more widespread movement toward better understanding then ever before.



SHOP EQUIPMENT NEWS

Black & Decker Electric Drill

The Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md., has recently added a new size to its line of portable electric drills. The new machine is shown in the illustration, and has a capacity up to $\frac{9}{16}$ in. in steel, and is provided with a No. 1 Morse taper socket. It is stated the machine will drill a $\frac{9}{16}$-in. hole through machine steel at the rate of $1\frac{1}{2}$ in. per min. without overloading the motor. The housing is of Magnalite, an aluminum alloy. The gears are packed in grease in a separate grease-tight compartment, and the drill spindle runs in a long bronze bushing, thrust being taken by a ball-thrust bearing. The motor is air cooled and will run continuously without overheating. The Morse taper socket is in the form of a separable sleeve secured in the drill spindle by means of a large knurled nut. By unscrewing this nut the entire taper socket is easily removed from the spindle. The drill shank protrudes slightly beyond the end of the taper socket, in order that the drill may be removed. This construction is used, for if it was necessary to leave room for the drift-pin slot the machine would be considerably less compact, and the end of the spindle would be some distance from the bearing. The machine has the customary pistol grip and trigger switch, which characterize Black & Decker drills. The machine weighs 21 lb., has a no-load speed of 600 r.p.m. and is supplied with interchangeable spade handle and breastplate, as well as electric connecting cable.

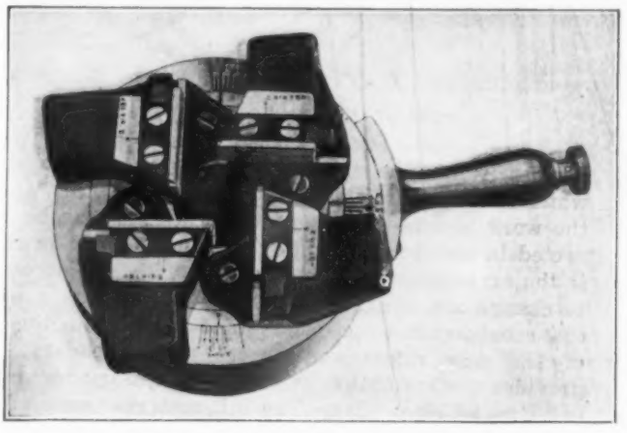


BLACK & DECKER $\frac{9}{16}$-IN. ELECTRIC DRILL

Landis Automatic Die Head

The Landis Machine Co., Waynesboro, Penn., has placed upon the market a new style of automatic screw-cutting die head which is different in design from other heads of this type in that the chasers are supported on the face of the head. This permits of easy access to the chasers when it is necessary to remove them for grinding or changing from one diameter to another. It is made of steel to insure a long life of hard service. The head is opened automatically by retarding the forward motion of the carriage, and is closed by hand. It is locked by the operating handle which contains a latch having a tongue milled on the lower end. This tongue is milled off center, thereby permitting of roughing and finishing cuts. To adjust the head for either roughing or finishing cuts merely requires a half turn of the latch to suitable graduations.

The head is graduated for all sizes of bolts and pipe, both right- and left-hand within its range. It is adjusted to size by means of a screw which engages the head body. Since the operating, adjusting and



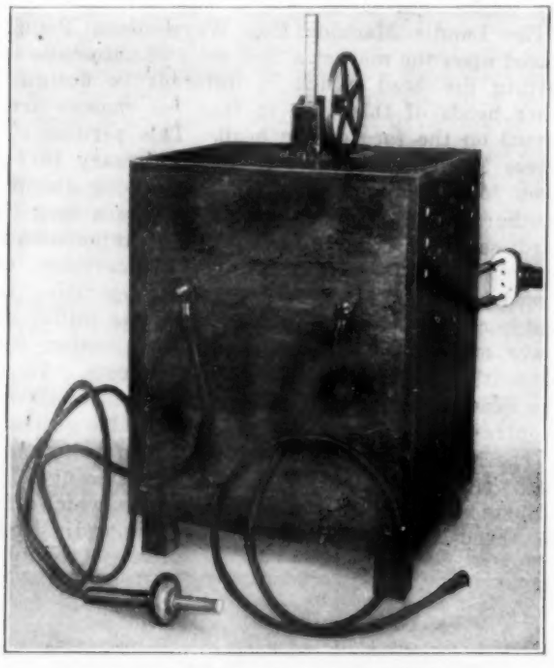
AUTOMATIC SCREW-CUTTING DIE HEAD

closing rings remain in a fixed position when the head is closed, the rotating of the head body within these rings gives the diameters within the range of the head. To set the head for left-hand threading, the screw which locks the latch pin is removed and the latch pin is rotated to the left-hand graduation. The locking screw is then replaced and the left-hand holders are put in place.

This head is applicable to practically all makes of screw machines and turret lathes which have sufficient space to swing heads of these diameters. The heads will be furnished with standard shanks, or special shanks will be furnished provided they will not be larger than the standard shanks. Where special shanks of dimensions greater than standard shanks are required a bushing can be used. This automatic die head employs the regular Landis chasers.

"Zeus" Arc-Welding Outfit

The "Zeus" arc-welding outfit is a product of the Gibb Instrument Co., 1644 Woodward Ave., Detroit, Mich. In this device the motor-generator customarily used has been supplanted by a transformer with no moving parts. It is stated that the current consumption is from 20 to 40 per cent. less than with the motor-generator type of outfit, and that it is particularly adaptable to overhead welding, and also to the welding



"ZEUS" ARC-WELDING OUTFIT

of cast iron. The outfit is built on the unit system, which allows the installation of a small machine, and if the work becomes heavier a duplicate set may be connected in parallel. One of the features of the machine is the arrangement for regulation. It is not necessary to change any connection for this purpose, as a wheel connected with a secondary and placed on the top of the case raises and lowers this secondary, and provides the regulation of current necessary for different sizes of electrodes. The inherent reactance of the outfit automatically stabilizes the arc for different arc lengths.

Manhattan Universal Casting Grinding Machine

The Manhattan Machine and Tool Works, 42-50 Market Ave., N. W., Grand Rapids, Mich., has recently placed on the market the universal casting grinding machine shown in the illustration. It is stated that the machine is easy and rapid to operate under the varying conditions such as are met in every-day use,

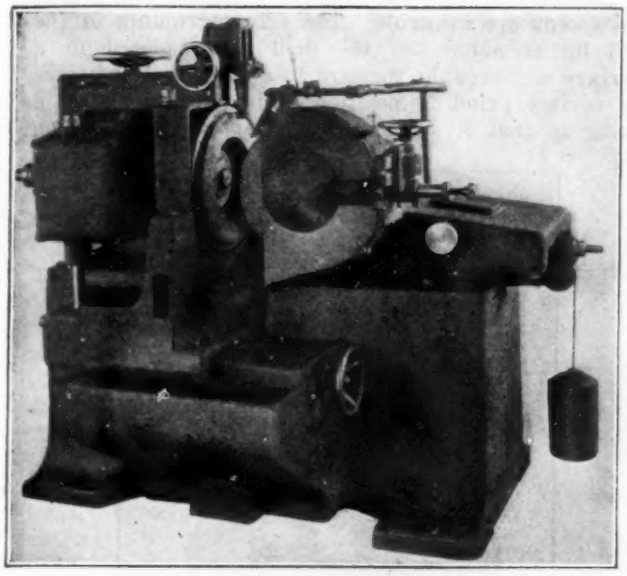
MANHATTAN UNIVERSAL CASTING GRINDING MACHINE

Wheel used, 12 in.; speed of wheel, 1600 r.p.m.; longitudinal travel, 12 in.; swing of wheel, 36 in.; length of swing shaft, 7 ft. 8 in.; shipping weight, 570 lb.

and that its rigidity, strength and flexibility are notable features. The universal movement is obtained by a universal coupling and sleeve, which gives a freedom of movement without undue loss of power. The long handle gives the operator a good leverage, so that the pressure applied to the grinding wheel can be easily regulated. Lubrication is taken care of by wick oilers and drip cups. The standard equipment consists of countershaft, counterweight, two pulleys for the counterweight cable and the machine itself.

"Reeves" Roll Grinding Machine

A machine for grinding rolls without centers up to 3 in. in diameter and from $\frac{1}{4}$ to 5 in. long has been designed by M. O. Reeves, and placed on the market by the Gardner Machine Co., Beloit, Wis. The working mechanism consists of a cutting or grinding wheel, shown at the right, rotating in a counterclockwise direction at ordinary grinding-wheel speed; and a ring wheel, at the left, of a fine, hard grain and grit, which is rotated in a clockwise direction at a speed of about 6 r.p.m. This wheel is known as the feeding wheel. Between the two wheels is a work rest which supports the rolls while grinding. This combination of wheels and work rest, when properly adjusted, causes the roll being ground to rotate with the same peripheral speed as the feeding wheel; and by placing the wheel rest so that the center of the roll is in contact with the feeding wheel along a line slightly above center of the feeding wheel, the roll is caused to advance past the cutting wheel at any predetermined speed. The process of grinding is continuous, one roll following another. The amount of stock removed at each cut depends upon the character of the metal and upon the finish required. The accuracy obtained under regular manufacturing conditions is stated to be from 0.0005 to 0.00025 inch.



"REEVES" ROLL GRINDING MACHINE

Capacity, work up to 3 in. in diameter and from ¼ to 5 in. long; speeds of grinding wheel, two, 1143 and 1800 r.p.m.; diameter of grinding wheel, 16 in.; speed of feeding wheel, 6 r.p.m.; speed of feeding wheel for dressing purposes, 378 r.p.m.; diameter of feeding wheel, 16 in.; sq.in. of surface ground per min., 60; reduction in diameter while roughing, 0.006 to 0.010 in.; reduction in diameter while finishing, 0.001 to 0.002 in.; floor space, 4½ x 6 ft.; weight, 4600 lb.

The cutting-wheel shaft is mounted in bearings supported by the slide shown at the right, the grinding wheel having feed motion for wheel wear only. If there is too much stock on the rolls being ground to be removed in one operation, they are run through the machine two or more times. Two wheel speeds are provided—1143 and 1800 r.p.m.—by a two-step cone pulley. A 16-in. wheel is used and the higher speed is used as the wheel wears down. The wheel slide is actuated either by a handle on the squared end of the shaft, at the extreme right, which is for a rapid motion, or by the small hand dial on the side of the slide which provides a micrometer adjustment and which is connected to the feed screw by means of a worm and wormwheel.

The wheel slide is counterweighted to take care of backlash in the feed screw and nut. A dresser is placed at the rear of the wheel hood. The handwheel at the top of this dresser is for a traverse motion of the diamond point, while the projecting knurled screw provides for the feed of the dresser.

The feeding wheel at the left is mounted in a ring chuck and revolves at 6 r.p.m. Provision is made, however, for a change of speed for dressing, the dressing speed being 378 r.p.m. A dresser is a permanent part of the machine and can be seen in the cut. The feeding wheel is 16 in. in diameter, and the drive is from a pulley on the countershaft to the pulley at the rear of the machine. From this pulley the drive is through a pair of bevel gears and a worm and wormwheel for the slow drive, and through the same pair of bevel gears and an additional pair of bevel gears and spur gears for the fast motion for dressing. The change from the slow to the fast speed is made by disengaging a clutch on the wormwheel, which then runs idle on the spindle, and engaging the two spur gears mentioned.

The wheel is adjusted in a vertical direction by means of the handwheel shown mounted on the top of the head to the left, this adjustment taking care of the traverse motion of the roll. Locating studs are provided on the top of the work-rest casting—one in front and one in the rear of the machine—these studs forming the gaging points for the work rest, which is so set that the center of the work is central with the cutting wheel. The front stud can be seen in the illustration but the work rest is not in place. After the work rest has been so set that the center of the roll to be ground is properly adjusted with regard to the cutting-wheel center, the driving wheel may be adjusted to feed the roll past the cutting wheel at any predetermined rate of speed. The further down the driving wheel is adjusted, the faster will the roll be fed past the cutting wheel. This machine will grind approximately 60 sq.in. of surface per min. for each operation, each roughing cut reducing the diameter from 0.006 to 0.010 in. and each finishing cut from 0.001 to 0.002 in.

The base of the machine on which are mounted the grinding-wheel head, the driving-wheel head, and the work rest contains a pan with a strainer, the lower part of the base forming a reservoir for the cutting compound. The pump is driven from the countershaft by a separate pulley, and is of the propeller type, and is not affected by grit. An opening is provided at the bottom of the base for cleaning out the reservoir when required. At the right side of the pan, as shown in the illustration, a handwheel is provided which actuates the work rest longitudinally, so that the latter may be placed exactly below the center of the roll to be ground. The machine occupies a floor space of 4½ by 6½ ft., and weighs approximately 4600 lb.

S. & C. "Easy-Lock" Holders and Interchangeable Counterbores

The illustration shows an S. & C. "Easy-Lock" holder with an interchangeable counterbore in place. These devices are both products of the S. & C. Manufacturing Co., 368 Mt. Elliott Ave., Detroit, Mich. The holders are made in four sizes, with either Morse taper shanks or straight shanks for screw machine work, and range from 1 1/16 to 2½ in. outside diameter, and are for cutters from ¼ to 3 in. in diameter inclusive. To lock a cutter in

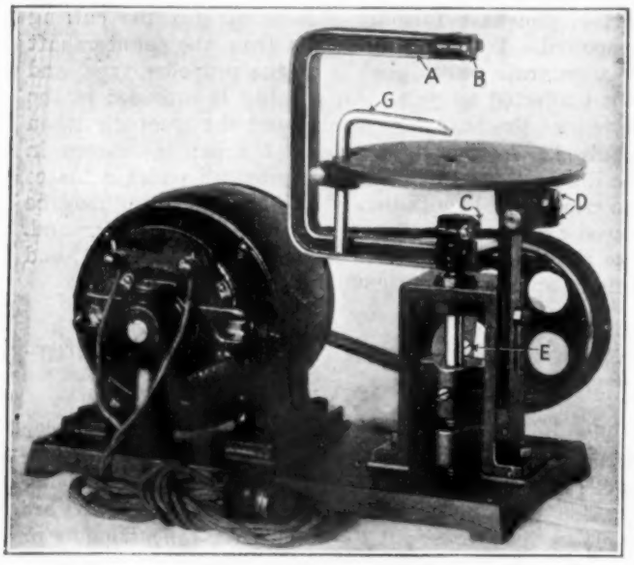
S. & C. "EASY-LOCK" HOLDER WITH COUNTERBORE IN PLACE

position it is simply necessary to insert the shank as far as the shoulder will permit and turn the knurled sleeve to the right. When the sleeve comes to a stop the cutter is securely locked. To unlock, it is simply necessary to turn the sleeve to the left; no spanner wrench being needed. A feature cited is that the shank of the cutter has a two-point drive instead of a setscrew drive, thus giving increased strength. The cutters are made in sizes of from ¼ to 3 in. and with pilots from 3/16 to 2½ in. in diameter. The pilots are held in the cutters by means of a shank that passes through the cutter, a split nut on the inner end serving to lock the pilot se-

curely in place. The advantage of this construction is that pilots of different sizes can be used in the same size cutter and it is also an easy matter to remove the pilot for grinding purposes. Another advantage cited is that the cutters can be held rigid in the holder for certain classes of work, or if desired, the cutter can be allowed to have play so that the cutter will float and the pilot follow the hole without cramping. The pilot shank is threaded for a considerable portion of its length in order to allow for the material used up in sharpening the tool. The "Easy-Lock" holders are also suitable for operation with tapered bridge reamers, which are also made and furnished by this company.

Bloomfeldt & Rapp Die-Filing Machine

The Bloomfeldt & Rapp Co., 108 North Jefferson St., Chicago, Ill., has recently placed on the market the die-filing machine shown in the illustration. This machine is driven by a ½-hp. motor of a type to suit the electric



DIE-FILING MACHINE

power of the customer. The machine has a tilting table that may be placed at any angle and is clamped by means of the clamping screws shown at *D*. The arm *A* is of the double type, saws or thin files being screwed by clamps at *B* and *C*, while a heavy file is fastened at *C* only. The adjustment of the stroke is by means of the screw *E* while the arm *G* is adjustable for holding the work in place while sawing or filing. The machine is 14 in. long, 9 in. wide and 12 in. high and weighs 50 pounds.

Bellevue Semi-Automatic Drill-Grinding Machine

The Bellevue Industrial Furnace Co., Detroit, Mich., has recently placed on the market the semi-automatic drill-grinding machine shown in the illustration. On this machine the drills are ground on the face of the wheel instead of on the flat side, it being claimed that this construction gives greater wheel life and greater ease in truing or sharpening the wheel. The machine is driven by means of an electric motor contained in the pedestal and has two-step cone pulleys so that two speeds are available. The actual grinding of the drill lip is automatic, the drill being placed in a carriage and brought forward to a gage that indicates the correct grinding position; this gage being on a spring so that it automatically snaps out of position

BELLEVUE DRILL-GRINDING MACHINE

when the grinding is begun. When placed in proper grinding position, the drill is positively locked and a vertical movement of the drill holder moves the drill up and down against the circumference of the wheel, at the same time rotating it. This motion is accomplished by gears. When one lip has been ground, a lever movement turns the drill holder to grind the next lip, where it is again locked in position. The machine can be indexed to handle drills with two, three, four or five lips. The grinding machine is made in twin form with two carriages and two grinding wheels mounted on a single base, so that either right- or left-hand drills can be ground. Taper-shank drills or reamers are handled in the spindle while straight-shank drills or reamers are chucked.

Taylor & Fenn High-Speed Vertical-Spindle Milling Machine

The Taylor & Fenn Co., Hartford, Conn., is now marketing the high-speed, vertical-spindle milling machine with single-pulley drive shown in the illustration. This machine is intended for various light vertical milling cuts, using high cutter speeds, and may also be used for light profiling work.

The machine is of the self-contained type with single-pulley drive, the power being taken from the main line-shaft through a 2-in. single belt, connecting with a tight and loose pulley on the left side of the ma-

chine, from where it is delivered directly to the driving pulley at the back. The tight and loose pulleys are guarded and the belt shifter is of interest. This is entirely inclosed within the guard and slides on two shafts which keeps the shifter always in vertical position. Where motor drive is desired, a special bracket is furnished that may be attached to the base of the machine; the drive being through a belt.

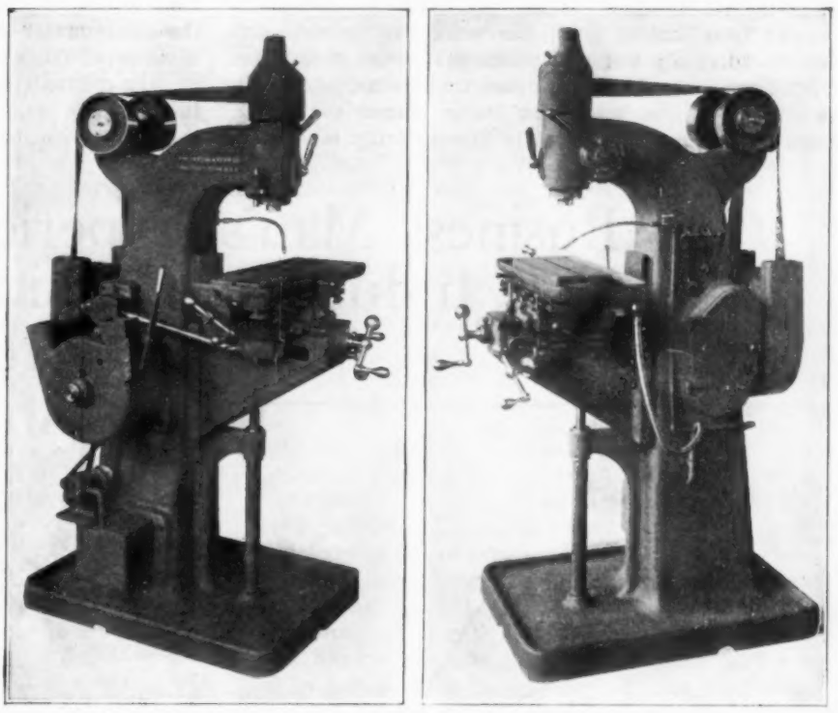
The base is a one-piece casting internally ribbed to insure rigidity. The main driving shaft extends through the machine and is connected with a spindle driving pulley on the back of the machine by a set of bevel gears. The spindle driving pulley is of large diameter and guarded. An endless belt extends from the spindle driving pulley over two idlers to the spindle pulley, and by removing the cover on the back of the guard this belt may be removed. The idler pulleys are adjustable to permit the proper belt tension to be maintained.

The various spindle speeds and the longitudinal feed of the table are obtained by means of change gears in the box on the right side of the machine. Adjustable stops are provided for cross and longitudinal feed and these operate whether hand or power feed are being used. The stops for the longitudinal feed are so designed that when the hand feed is being used the power feed cannot become engaged.

The oiling system is a feature of the machine and has been so designed that access is easy to all parts requiring lubrication. A central-reservoir system is provided in the table of the machine, from which the oil is conveyed through copper tubes to the bearings on the slides.

The lubricant pump is a self-contained unit, the tank to which the pump is attached extending inside of the column of the machine. The whole unit can be quickly removed and facilities are also provided for quickly filling or draining the tank. The belt runs from the main driving pulley directly to the pump pulley and is of the endless variety. The lubricant pipe ends in a section of flexible tubing so that the stream of compound can be directed as desired, and a convenient shut-off valve is placed within easy reach.

Eleven ball bearings are used in the construction of the machine. The spindle has a long bearing of large diameter and is counterbalanced by a spring working directly in connection with the rack for moving the spindle up and down. This spring may be so adjusted as to make the quick return of the spindle possible when this is desired. A stop is provided on the quadrant for feeding down to a given depth. Double-row thrust bearings are used on the table screw and ball-thrust bearings are provided on all elevating screws. The regular equipment includes pump, tank, pipes and connections, spindle driving belt, wrenches, change gears, etc.

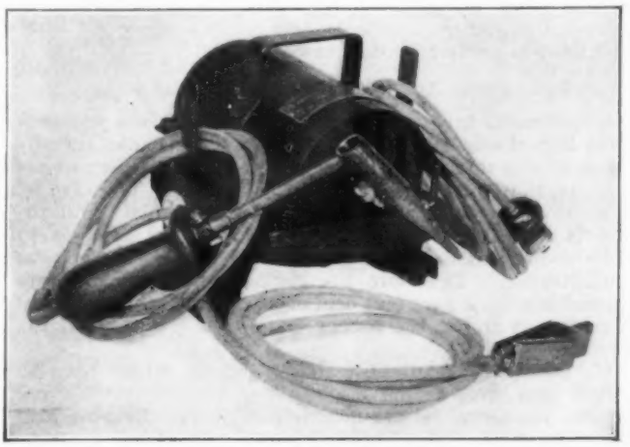


TAYLOR & FENN VERTICAL-SPINDLE MILLING MACHINE

Longitudinal movement, 11 in.; cross movement, 6 in.; vertical adjustment of knee, 10¼ in.; vertical movement of spindle, 2 in.; maximum distance from end of spindle to top of table, 10¼ in.; center of spindle to face of column, 9 in.; size of table over all, 10 x 27 in.; working surface of table, 6 x 18 in.; T-slots in table, ⅝ in.; number of power feeds, thirty-three, 0.0019 to 0.013 in. per spindle revolution; number of spindle speeds, thirty-eight, 500 to 3100 r.p.m.; taper hole in spindle, No. 7 B. & S.; size of hole through spindle, ⅝ in.; diameter of spindle pulley, 4¼ in.; width of belt, 1⅜ in.; speed of main drive shaft, 290 r.p.m.; diameter of tight and loose pulleys, 10 in.; width of belt, 2 in.; diameter of large driving pulley for spindle, 20 in.; floor space, 41 x 41 in.; weight, 1200 lb.

General Electric Lead-Burning Transformer

This lead-burning transformer, a recent product of the General Electric Co., Schenectady, N. Y., can be used for lead burning, soldering electric terminals, splicing wires and tinsmith jobs, and even brazing can be done by placing the work between a blunt carbon point and a piece of cast iron. The transformer is designed to be connected to the ordinary 110-volt, alternating-current lighting circuit. Heavy rubber-covered terminal leads are used to convey the low-voltage, heat-producing current to the work, one terminal ending in a clip for fastening to some convenient portion of the work while the other terminal has a carbon holder arranged with



GENERAL ELECTRIC LEAD-BURNING OUTFIT

an insulated handle. When the welding carbon is brought into contact with the work the pointed end becomes intensely hot and melts the metal over a restricted area. It should be noted that no arc is drawn, the end of the carbon point being heated to such a temperature that the metal in the vicinity is melted. The device uses about 800 watts while in actual use, the consumption dropping to 4½ watts when the point is removed from the work. It is stated that the device is very convenient in plumbing, roofing and tank-building jobs, as well as other such work. It also claimed that jobs can be done much faster than with gas.

A Business Man's Experience With Industrial Training

By E. A. BARNES
General Electric Co., Fort Wayne, Ind.

Here is a message of the greatest value for every manufacturer in America. It is from a representative of a firm which employs thousands; from a man who knows whereof he speaks. The war-emergency opened his eyes to the remarkable value of a training department such as was brought to his attention by the United States Training Service. At first it was temporary—for new employees. Then the writer and his associates saw the wonderful possibilities of a permanent training department. In a direct and most interesting way he tells, for the benefit of all who will read, just what his training department has done and what it proposes to do.

IN ALMOST every meeting of employers of labor the question which seems uppermost in the minds of factory managers, and which is almost sure to come up for discussion, is that of the enormous labor turnover in the last few years. Unquestionably this excessive turnover has been occasioned by unprecedented war demands for labor, which developed the practice of scalping and stealing labor from one community or plant by another throughout the country.

While this turnover is estimated to cost the employer from $25 to $100 per person, it is by no means the only loss in the factory that needs attention. The loss I have in mind is the loss due to the improper placing of men in the establishment and continuing, or attempting to continue, them in work for which they are not particularly fitted or in which they are not satisfied.

Few industrial establishments have a real system of hiring, selecting, training, inspecting, and upgrading their help. In too many cases the old system of lettng the shop foreman hire the men, without much consideration as to the applicants' ability and training, is still in effect, with the result that many of the new employees spoil work, ruin expensive machinery and tools, and really produce but little work that is perfect enough to be shipped.

First Step Toward Improvement

A systematic investigation of general conditions certainly is the logical first step in improving conditions. An investigation of this sort probably will uncover a great many shortcomings, that the management either has been unaware of or so used to, that they are not duly appreciated. But future industrial competition promises to be so keen as to make it imperative that all removable losses shall receive due attention. Therefore the company with which I am connected is giving a great deal of attention to the personnel of our plant and to the proper training and placing of the employees.

We conduct specialized training courses which may be divided into three groups.

First, the school for the graduate engineer. Here we give the young technical-college graduates an extensive course through the shops, laboratories, and testing departments, supplemented by lectures on special subjects.

Second, the apprentice school for machinists and toolmakers. In this school selected applicants are given a short preliminary course to see if they are likely to develop into efficient workmen. Those who pass this preliminary course sign a contract for four years (the time required for the completion of the course), during which the men are given one and one-quarter hours' daily instruction in such subjects as drafting, mathematics and business English. The other hours of the day are spent at the machine or bench, where they are under the direction of experienced instructors. These apprentice students are paid a fair and graded rate during the entire time, and at the end of the course are given a bonus if they pass their school examinations, and still a second bonus if they pass their mechanical examinations.

Third, intensive specialized courses. We have also found it exceedingly profitable to give an intensive training course in drafting for women, who, on completion of the course, are transferred to regular drafting work in the engineering and drafting departments. Women clerks in the factory also are given the advantage of special courses in blueprint reading and factory routine, which familiarizes them with the product and systems to the extent that they can readily grasp situations and intelligently carry on the work.

In general, we are prepared to give to special classes of our employees intensive instruction in subjects pertaining to their daily work that a few years ago would have been thought wholly unnecessary.

Temporary Training Department

Provision having been made for the training of the future engineers, special machinists, draftsmen, clerks, and future office executives it would seem that the training and upgrading of the man in the shop should be taken in hand and followed continuously and vigorously.

Our experience along this line extends over two years. When this country entered the war we were confronted with the common problem of obtaining adequate help to make up for the losses of young men entering the service, and were attracted by the bulletins put out by the U. S. Training Service concerning the vestibule school or training department. An investigation of some of the established schools developed the fact that they were in many respects similar to suggestions that we already had under consideration. We therefore decided to establish a real training department in which all classes of drilling machines, grinding machines, engine lathes, turret lathes, and automatic screw machines would be installed, and where competent instructors would take applicants for employment and train them a sufficient length of time to guarantee their being productive when transferred to the factory. The rates to be paid the trained workers were attractive, and steady employment was insured.

We ran this school until the armistice was signed, when the necessity for it in its inital form naturally ceased to exist. The reports from the foremen in the factory indicated that the employees who had been trained in this vestibule school were very efficient and desirable help; these trained operators were, in fact, much sought after and competed

for by our various manufacturing departments. These facts lead us to the conclusion that the systematic training system is a good thing, and that it should be installed permanently.

With such a training school in operation, it is our intention to refer to this school all newly engaged machine operators who cannot furnish evidence of having served time or worked efficiently in a machine shop. In this school the capabilities of such new employees will be gaged before they are allowed to get into the shop proper.

Before we hire any more help we feel that our present employees should receive close attention and we propose to have "instructors at large," who are bright mechanics, going around the shop picking out operators who, due to lack of initial training, are less efficient than their neighbors. Such operators will be sent to the training department for a short period and will then be returned to their regular departments much improved, we believe, because they will have received individual, intensive training which they cannot get in the shop itself.

In connection with this training department we expect to have classes in blueprint reading. Information will also be presented which will promote better relations between the employee and employer. Much of the general unrest that exists in shops today is brought about by the lack of appreciation of what the employer is doing, or would like to do, for the men. We feel sure that much benefit will be derived from an understanding of the situation that comes with practical demonstration. In other words, we will upgrade and educate our less fortunate employees, and in the hiring and selecting of new ones we will attempt to launch them into the factory world with a better knowledge of what is expected of them than has been possible in the past.

Systematic training may appear to be an exceedingly expensive enterprise in which only a few concerns can afford to embark. This is by no means the case. Our statisticians have shown us that it costs from $25 to $100 to train each employee. If, therefore, this system of scientific training enables us to cut our turnover in two, or even reduce it by one-quarter, the amount saved would be unbelievable.

If business conditions should not warrant a continued hiring of new help, the training department, equipped as it is with modern machinery, can be used to advantage to test out applicants for better positions. It has been developed that as soon as some systematic training system is put into effect, operators who under ordinary conditions would be satisfied to stay on one particular job, become ambitious to advance, and if the opportunity is held out to them through the medium of these "instructors at large," etc., their applications for advancement and trial elsewhere can be given much better consideration.

[Note: This article is from a bulletin issued by the United States Training Service, 618 Seventeenth St., N. W., Washington, D. C. Copies of this and other bulletins, also free expert advice on establishing training departments may be secured on request to Charles T. Clayton, Director, at the above address.]

Machine-Tool Prices

By S. Owen Livingston
President Grand Rapids Grinding Machine Co.

There is one point of view in the matter of machine-tool prices that, it seems to the writer, is not receiving as much consideration as it should.

Some machine-tool buyers seems to expect that all machine-tool prices should be reduced, irrespective of the amount of advance that was made in those prices during the war, and because some lines of machine tools have been reduced in price, these buyers seem to expect that *all* prices should be reduced.

It would be a comparatively easy matter for any purchaser of machine tools to ascertain what the price of a corresponding machine was, say three and ten years back. It is a well-known fact that many machine tools have not only doubled, but in some cases, more than trebled in price in the last three years. The contention that such prices should come down cannot be successfully combated. There are other machines, however, which it can be easily shown, have only increased a total of less than 50 per cent. in the last ten years and less than 33⅓ per cent. in the last three years. Makers of these lines obviously cannot be expected to follow the cuts in the lines that made the abnormal increases. Expecting such a reduction is a poor way of showing gratitude for the reasonable prices maintained during the strenuous times just past, and it obviously is not possible.

Labor and material have advanced in round figures 100 per cent. and all the other incidental expenses of doing business have also gone up proportionately. The increase in cost is so much in excess of 50 per cent. that the manufacturer, whose prices are today only 50 per cent. higher than they were ten years ago, is entitled to an increase, rather than a decrease in his present prices.

The writer has no desire to see machine-tool prices remain at an unhealthy altitude, but his plea is that in looking for reductions, the prospective buyer separate the sheep from the goats or, perhaps it may be expressed in the wish that the buyer refrain from trying to make those who have been the sheep, the "goats" in the present situation.

The editorial by Mr. Colvin in a recent number of the *American Machinist* calls attention to the incontrovertible fact that the machine-tool industry at the present time contributes more to the financial and mechanical advantages of this country than any other industry, and with all, for a very much smaller percentage of profit. The meager profits make it impossible to train and hold that high grade of mechanics which must be utilized if America is to maintain her position, to say nothing of making progress in the machine-tool industry. While that condition is true, it is folly for machine-tool builders or buyers to figure on any greater reductions than will serve to eliminate the excessive advances which were based on supply and demand, irrespective of cost of production.

How Would You Prevent This Grinding Trouble?

By A. E. Holaday

On page 705 of *American Machinist*, John Vernon asks how he can avoid the warping of a cold-rolled steel plate to which is riveted a cast-iron bracket. He further states that cold-rolled steel is not a prime requisite, providing he can get other material with reasonably smooth surfaces.

Why not cast the piece of semi-steel or malleable iron? By casting the piece complete he would avoid the operation of riveting on the already cast bracket. I know that it would be entirely practical, as we are now casting a large tonnage of similar work, which must have a fine surface suitable for nickel plating. It would be necessary to allow but one degree of draft on the sides to make it practical to mold.

A year or two ago an inquiry appeared in the *American Machinist* [page 604, Vol. 44] as to how you would make a certain nail which was there illustrated, and I suggested casting in malleable iron. We are now making the nail in millions from this material.

Sparks from the

Foundrymen Are Perfecting Plans for Annual Meeting

A Local Committee, Formed in Philadelphia Has Secured More Than 25 Technical Papers for the Professional Sessions

Plans for the twenty-fourth annual meeting of the American Foundrymen's Association, which will be held in Philadelphia during the week of Sept. 29, are rapidly being perfected. Several delegations of British, French and other European foundrymen are expected to attend as the result of arrangements now being made in Europe by A. O. Backert, president of the Association. Special stress, therefore, will be laid on both the entertainment and technical features of the program this year. Considerable progress already has been made in both directions.

A local entertainment committee has been formed in Philadelphia and over 25 papers and addresses have already been secured for the professional sessions which will probably open on Tuesday, Sept. 30, concluding Friday, Oct. 3. Simultaneous sessions are being planned for Wednesday and Thursday, Oct. 1 and 2, with special sessions as usual for the discussion of gray iron, steel and malleable foundry practice. The customary exhibition of foundry and shop equipment will be held in the Commercial Museum where unusually satisfactory facilities are available, and the advance reservations for space already received indicate that the exhibition this year will be the largest ever held.

The Philadelphia local committee was formed at a recent meeting of the Philadelphia Foundrymen's Association. Thomas Devlin, Thomas Devlin Manufacturing Co., president of the Philadelphia Association, and Howard Evans, J. W. Paxon Co., secretary, are ex-officio members of this committee. The other members include G. H. Clamer, Ajax Metal Co., Philadelphia; C. R. Spare, American Manganese Bronze Co., Holmesburg, Penn., H. W. Brown, Tabor Manufacturing Co., Philadelphia; Frank Krug, White & Bros., Inc., Philadelphia, and J. D. Hibbs, J. W. Paxon Co., Philadelphia. It is expected this committee will be considerably enlarged and its work organized through the medium of subcommittees a little later on.

Unusual historical interests are attached to the forthcoming convention, since it was at Philadelphia in 1896 that the American Foundrymen's Association was organized as a result of a movement led by the Philadelphia Foundrymen's Association. It is expected that the entertainment program which is being prepared for the coming convention will emphasize the prominence of the Quaker City as a foundry center. The details are still to be worked out but it now seems assured that one of the features of the program will be a shad dinner of the variety for which Philadelphia is famous. Other unique entertainment features are contemplated.

Among the technical papers for which arrangements already have been made are the following: "Results of an Investigation of Steel Castings on German Submarines," by Prof. William Campbell, Columbia University, New York; "Training Men for Foundry Work," by C. C. Schoen, training section, U. S. Department of Labor, Washington, D. C.; "The Comparative Qualities of Electric and Converter Steel Castings," by John Howe Hall, Taylor-Wharton Iron and Steel Co., High Bridge, N. J.; "Experiments With Melting High Sulphur Malleable Scrap," by A. W. Merrick, General Electric Co., Schenectady, N. Y.; "The Side Blow Steel Converter and Its Possibilities for the Gray Iron Foundry," by George P. Fisher, Whiting Foundry Equipment Co., Harvey, Ill.; "Micromotion Study for Foundrymen," illustrated by moving pictures, by Maj. Frank B. Gilbreth, Providence, R. I.; "Electric Furnaces for Foundry Use, Specially for Annealing Steel Castings," illustrated by motion pictures, by T. F. Baily, Electric Furnace Co., Alliance, Ohio; "Methods for Determining When Malleable Iron Is Over or Under Annealed," by Maj. W. P. Putnam, Detroit Testing Laboratory, Detroit; "Relation Between Machining Qualities of Malleable Castings and Physical Tests," by Edwin K. Smith, Wisconsin Malleable Iron Co., Milwaukee; "How to Secure Best Results in Combining Hoisting Apparatus With Molding Machines," by W. C. Briggs, Shepard Electric Crane and Hoist Co., New York City; "Concrete Foundry Floors," by H. H. Haley, American Foundry Equipment Co., New York; "Personnel Problems of Modern Industry," by C. D. Dyer Jr., consulting engineer, Philadelphia; and "Foundry Sand-Handling Equipment," by H. L. McKinnon, the C. O. Bartlett & Snow Co., Cleveland.

* * *

Machinery Club of Chicago Holds Dinner

The Machinery Club of Chicago held a dinner on Thursday evening, May 22. The dinner was followed by an illustrated lecture by Sergeant Luders upon the subject of the Battle of Gallipoli and the Suez Canal.

Allied Machinery Co. of America Increases Capital Stock

The Allied Machinery Co. of America has increased its capital stock to $5,000,000. This was made necessary by the decision of the American International Corp. to group all of its machinery export-selling subsidiaries under one head. This move contemplates the complete absorption of the Allied Construction Machinery Corp. by the Allied Machinery Co. of America. The Allied Machinery Co. de France and the Allied Machinery Co. d'Italia will retain their corporate entities but their parent corporation will be the Allied Machinery Co. of America rather than the American International Corp. as before. This is also true of the Horne Co., Ltd., of Japan, which was purchased early in the year by the American International Corp.

All shares of the Allied Machinery Co. of America will, as before, be owned by the American International Corp.

The Allied Machinery Co. of America was formed in 1911 by interests associated with the National City Bank of New York to sell machine tools in Europe. In 1916 it was taken over by the American International Corp. which immediately set about to expand and organize the business on a larger scale. The business has increased rapidly and today the company is operating in 14 countries.

J. W. Hook will continue as president of the Allied Machinery Co. of America, in general charge of the business. F. A. Monroe, S. T. Henry and T. G. Nee have been elected vice presidents. Mr. Monroe is in charge of the administrative affairs of the company. Mr. Henry is in charge of sales and advertising and Mr. Nee is at present in Japan devoting his attention to the affairs of the Horne Co., Ltd. Mr. R. P. Redier is general sales manager of the company, with headquarters at Paris.

* * *

Wages Rise 107 Per Cent.

According to the New York *Times*, a report just issued by the New York State Industrial Commission says that during the four years since March, 1915, wages have increased 107 per cent. and the number of employees 18 per cent. In March, 1919, there were 9 per cent. fewer workers in the factories of the State than in the same month of 1917, but the payrolls were 27 per cent. larger. In many industries there were more workers than were employed in February, when the decrease in employment appears to have been at a lower point than for a long time previously.

World's Industrial Forge

By E.C.Porter, News Editor

Training Helps Workers to Help Themselves

Three-fourths of the industrial workers in America are handicapped by lack of proper training in their respective tasks, according to the U. S. Training Service of the Department of Labor. The work of the Service is to increase the efficiency of this "insufficient three-fourths," rather than to stimulate the output of the one-fourth already producing at a satisfactory rate, says a bulletin entitled, "Some Advantages of Industrial Training," now being distributed free by this branch of the Government.

Bringing about a big increase in output of the average plant, the Government contends is wholly within the possibilities, if the following steps are taken: (1) A careful analytical survey of the operations in the plant to ascertain where existing methods can be improved; (2) the formulation of a definite program of training, either in a separate department or "on the floor" in direct conjunction with production; (3) the instruction of those workers who are most in need of it, and (4) the upgrading of those in the next higher strata. A training department helps workers to help themselves.

Another question of keen interest to the working man and the employer alike, taken up in this bulletin, is the effect of training on labor turnover. It points out that the turnover for the country at large is at least 250 per cent., placing an annual burden of $1,250,000,000 on our manufacturing industries. Basing his claim on the experience of several score of plants where training has been installed, the author maintains that such instruction in a factory causes a big reduction in turnover. The trained employees can more readily find suitable work and are more easily retained in a plant. Training contributes to a better spirit among employees and develops better teamwork with the employers. This bulletin is one of a series, all of which can be had for the asking. Requests should be addressed to the U. S. Training Service, care of the Department of Labor at Washington.

* * *

High Record for April Foreign Trade

April exports surpassed the previous high record by nearly $100,000,000, according to recent announcement made by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Exports for the month totaled $715,000,000, as compared with $623,000,000 for January, the previous high mark. For March of this year the total was $605,000,000, and for April a year ago, $501,000,000. For the 10 months ended with April the exports were valued at $5,705,000,000, as against $4,884,000,000 for the corresponding period last year.

Imports for April totaled $273,000,000 in value, a gain of $5,000,000 over the $268,000,000 announced for March, and a decrease of $6,000,000, as compared with the $279,000,000 for April of last year. Imports for the 10 months ended with April are put at $2,474,000,000, as compared with $2,362,000,000 for a similar period in 1918.

* * *

Convention of American Boiler Manufacturers

The thirty-first annual convention of the American Boiler Manufacturers' Association will be held at Lafayette Hotel, Buffalo, on Monday and Tuesday, June 23 and 24.

This Association consists of all builders of high-pressure steam boilers, of both water-tube and fire-tube types. An interesting program has been arranged. Full information can be had by addressing H. N. Covell, secretary, at 191 Dikeman St., Brooklyn, N. Y.

* * *

Industrial Safety Council Organized

The Geneva Industrial Safety Council, Geneva, N. Y., has been recently organized with E. R. Dobbin, Empire Gas and Electric Co., chairman; E. Ridley Burroughs, Standard Optical Co., vice chairman; Russel Allen, Tay & Bowen Engine Co., secretary, and H. D. Tarbell, Geneva Cutlery Co., treasurer. Practically all the industrial and manufacturing interests in and about Geneva have coöperated in this new Industrial Safety Council which purposes to obtain for all employees the maximum of personal safety, comfort and contentment while at work.

* * *

Contracts for New Building

The O. R. Adams Manufacturing Co., Inc., Rochester, N. Y., has increased its capital stock from $30,000 to $150,000 and has awarded a contract for a new building for the manufacture of the Adams Short-Cut lathe. The new building will provide about 4500 sq.ft. of floor space and will cost approximately $15,000.

F. H. Brown, formerly sales manager of Sherritt & Stoer Co., Philadelphia, has been appointed president and general manager. O. R. Adams is secretary and treasurer.

Seventh National Foreign Trade Convention

Will be Held in San Francisco on May 12-15, 1920. It Will be the First of These Conventions to Be Held on the Pacific Coast

The seventh National Foreign Trade Convention will be held in San Francisco, Calif., on May 12-15, 1920. It will be the first of these important conventions to be held on the Pacific Coast, previous conventions having been held at Washington, D. C., New Orleans, St. Louis, Pittsburgh, Cincinnati and Chicago. In deciding on San Francisco for the convention city, the National Foreign Trade Council was influenced by the growing importance of the Pacific Coast in the foreign commerce of the country, and by the enthusiastic support which the Far West has given all previous foreign-trade gatherings.

Manufacturers from the East welcome the prospect of a San Francisco convention at which the problems of the "Twentieth Century Ocean" will be fully discussed. With many of the markets of Europe restricted by embargoes, it is natural for manufacturers to expand their trade in South America, and to look toward new fields among the great populations of China, Japan, India, Siberia and Australasia. The importers of the country, both merchants and manufacturers, have a special interest in the trade of our western ports. Shipping men will find on the Pacific a marine situation of national interest, brought about by the development of a large Japanese merchant fleet aided by government subsidies and low labor costs. Traffic managers from the interior of the country will be enabled to see and judge at first hand the ports through which much of their sales will be routed in the future.

While the convention itself will be held in San Francisco, it will really be a Pacific Coast gathering, and the cities of Seattle, Tacoma, Portland and Los Angeles will share with San Francisco in the attention of the visiting delegates.

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Railroad Blacksmiths Will Hold Convention in Chicago

The International Railroad Master Blacksmiths' Association will hold its annual convention in Chicago, Aug. 19, 20 and 21. This organization has been recognized and encouraged by the railroads on account of its educational value. All master and foremen blacksmiths that can be spared from the various railroads without detriment to the service will be in attendance.

Business Items

The executive and sales offices of the Max Ams Machine Co., Bridgeport, Conn., have moved to 101 Park Ave., New York.

The Tacony Steel Co. has opened a Cleveland office in the Swetland Building under the direction of W. W. Keefer, district sales manager.

L. V. Estes, Inc., industrial engineers and accountants, has removed its offices to the Century Building, 202 South State St., Chicago, Ill., where it will occupy the entire 15th floor.

The Waterloo Cement Machinery Co., Waterloo, Iowa, has changed its name to the Waterloo Construction Machinery Co. H. B. Lichty is president and L. A. Kliebenstein is secretary.

M. C. Green has discontinued his general repair and machine work to specialize in preheating devices, experimental and research work, also acting in the capacity of a consulting engineer. The office and demonstration plant is located at 325 Campbell St., Williamsport, Penn.

The Monometer Manufacturing Co., Ltd., Birmingham, England, announced that during the war it has equipped the English government aircraft factories with its system of melting furnaces and also has equipped the most important government factories with furnaces for the melting of all ferrous and non-ferrous metals.

The Collins Rotary Safety Razor Sales Co. has under construction a factory located on West St., between 43rd and 44th Aves., Chicago, Ill. The size of this building is 158 x 200 ft., two stories high; it is of brick, concrete and steel construction and is expected to be completed by July 1. H. A. Hassalquist has been appointed superintendent and production engineer of the new building. He has been identified with a number of large concerns during the past 29 years.

Meyer, Strong & Jones, Inc., has succeeded to the engineering practice of Henry C. Meyer, Jr. and Bassett Jones, associated, and of William E. S. Strong. Mr. Strong was connected for many years with the American Raditor Co. as chief engineer. During the past year he has been engaged in war work, with MacArthur Bros. Co., in connection with the United States bag-loading plant No. 2 at Woodbury, N. J.. Mr. Meyer and Mr. Jones have been engaged in consulting work in New York City since 1903. Messrs. C. A. King, H. E. Meeker, H. F. Richardson and J. J. Ruckers who have been associated with Messrs. Meyer and Jones for a number of years, will be in charge of the work in the new organization. The new firm will act as consulting engineers for steam and electrical work, power plants, etc., and will have offices at 101 Park Ave., New York City.

Trade Currents

Cleveland Letter

The last week of the month has proved to measure up better in volume of machinery and machine-tool business in the Cleveland and northern Ohio district than expectations at the beginning of May would have warranted. While no large individual orders have come forward during the period, there has been an increase in the number of individual items of equipment called for. Much of this has been of the staple variety, grinding machines, shears, punches and similar equipment constituting the main business.

Japanese Firm Places Order

The outstanding feature of the week is the entry into the Cleveland market by a big Japanese manufacturing firm, which is about to place an order totalling $35,000 for miscellaneous equipment of small machinery and tools, with which it plans to equip a machine shop to be operated in conjunction with its manufacturing establishment.

Aside from this inquiry the best development is the larger number of orders being received for new machinery. Not since the now memorable Nov. 11 has there been such interest in new equipment, in the opinion of more than one leading distributor, as there has been in the last two weeks. Orders placed in the last few days of May show that an equal amount of new material and used machinery is being taken. The Cleveland trade is well satisfied with the manner in which the Government is easing off in the disposal of used equipment, for this method is taken as the best means of indicating there will be no immediate falling off in prices. It is largely this belief that is keeping consumers backward in the placing of their orders, machinery interests say, and because they now realize there will be no early reductions, the reasons for optimism for the next few months in the trade are well founded.

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Import Restrictions on Emery Removed

The War Trade Board announces that all existing restrictions upon the importation of emery and emery ore have been removed, and that shipments of such commodities may hereafter be entered under General Import License No. PBF-37, described in W. T. B. R. 726, issued May 8, 1919.

Shipments of emery and emery ore now in the United States, entered under import licenses which were issued upon the condition that such emery or emery ore would not be used for consumption until a period of 60 days had elapsed from the date upon which the restrictions against the importation of emery and emery ore were removed, are released for immediate use, and such condition need not be further observed by the holders of such licenses.

Personals

O. T. Smith, for several years connected with the Colonial Steel Co. in the New England district, is now associated with the Aborn Steel Co., Boston, Mass.

P. F. Sheeran has returned to the organization of J. J. McCabe Lathe and Machinery Corporation, N. Y., and has resumed his duties as sales and advertising manager.

C. H. Parr has been appointed chief draftsman in the engineering department of the Hart-Parr Co., Charles City, Iowa. H. E. McGray is chief engineer of this department.

F. W. Shumard, supervisor of the machine and tool branch of the Motor Transport Corps, Washington, D. C., has left the Government service and is now superintendent of the Arnold Hellmuth Manufacturing Co., Brooklyn, N. Y.

Walter E. Flanders, pioneer in the automobile industry, has resigned his connection with the Maxwell Motor Co., of which he was for many years president and more recently chairman of the board of directors. His future plans have not been made known.

Lieut. H. J. Williams, Engineering Division, Ordnance Dept., U. S. A., recently discharged, has been appointed engineer of the Beacon Falls Rubber Shoe Co., Beacon Falls, Conn. Prior to his entry into the service, Mr. Williams was consulting and mechanical engineer and also on the teaching staff of Pratt Institute, Brooklyn, N. Y.

Charles T. Fallon has been appointed sales manager of the Tacony Steel Co., which has recently opened offices in the Oliver Building, Boston, Mass. Mr. Fallon has been in the U. S. Naval Reserve Flying Corps for two years and prior to his enlistment was connected with the Wheelock Lovejoy Co.

I. Hall, managing director and engineer of the Monometer Manufacturing Co., Ltd., Birmingham, England, will sail for this country in the course of another month to make arrangements for the organization for the manufacture of all kinds of Monometer furnaces for melting, annealing, carbonizing and heat-treatment of steel.

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Want to Represent American Firms in France

The Société Francaise D'Action Economique, 1 rue des Italiens, Paris, France, which is represented here by Daniel T. Pierce, 149 Broadway, New York, reports that it has inquiries from French firms who desire to secure American agencies in France for building hardware, portable wooden dwellings, automatic machinery, electrical supplies, and oil and lubricants for industrial purposes.